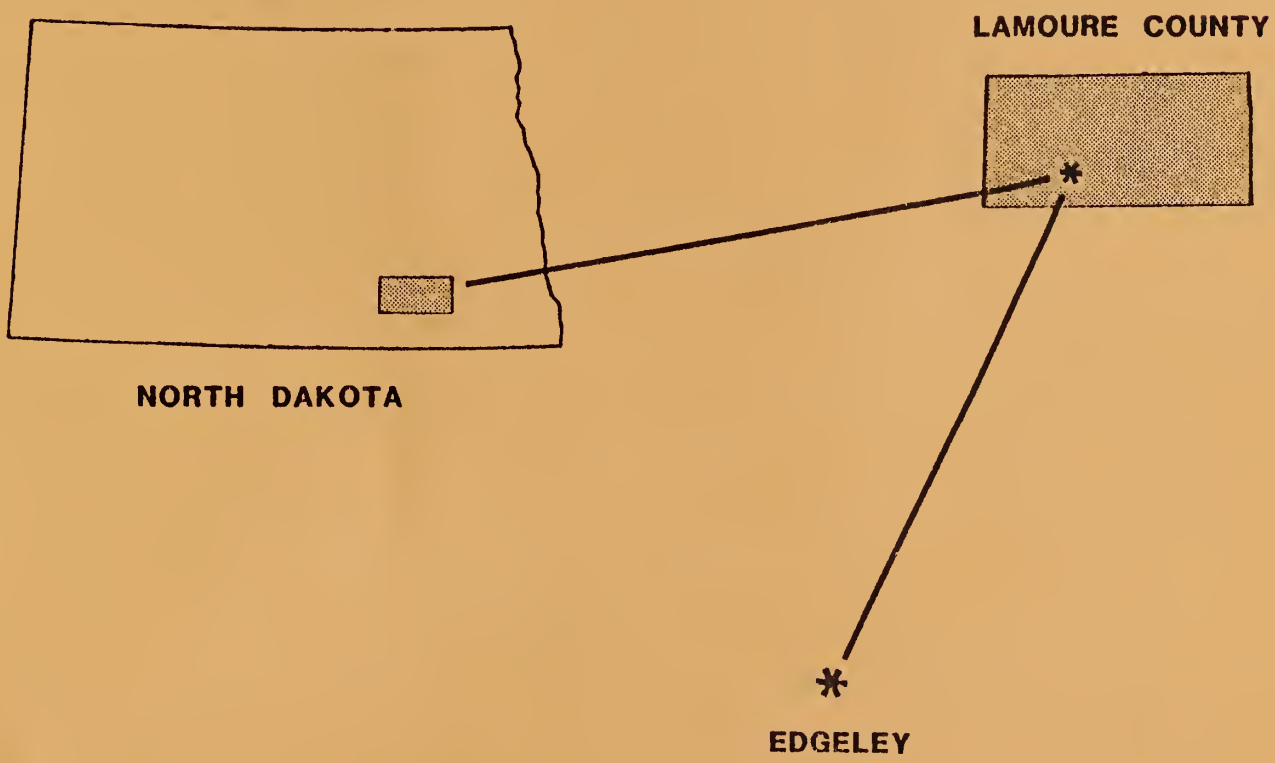
United States
Department of
Agriculture

Soil Conservation
Service

Bismarck
North Dakota

EDGELEY FLOOD PLAIN MANAGEMENT STUDY LAMOURE COUNTY, ND

Prepared for the
City of Edgeley



FLOOD PLAIN MANAGEMENT STUDY

OF AN UNNAMED TRIBUTARY

OF THE MAPLE RIVER

AND ADJACENT CRITICAL FLOOD PLAIN AREAS

IN THE VICINITY OF EDGELEY

LAMOURE COUNTY, NORTH DAKOTA

Prepared by

United States Department of Agriculture
Soil Conservation Service
Bismarck, North Dakota

For the

City of Edgeley

In cooperation with the

Lamoure County Water Resource District
West Lamoure County Soil Conservation District
and the
North Dakota State Water Commission

FOREWORD

The Flood Plain Management Study defines the flood characteristics of an unnamed tributary to the Maple River near the City of Edgeley, LaMoure County, North Dakota. Land uses in the study area include transportation, residential, commercial, agricultural, recreational and industrial. Compatible land use in the flood plain must be maintained to ensure against increased damages in the future from indiscriminate development.

This cooperative report will provide the guidance to local officials in planning land use and regulating development within the flood plain. The 10-, 50-, 100- and 500-year frequency floods were selected to represent varying degrees of major flooding that could occur in the future. The 100-year[1/] and the 500-year[2/] frequency floods are necessary for planning land use and development in the flood plain. Flood hazard photomaps show the approximate areas subject to inundation by the 100- and 500-year flood events. Flood profiles show the water surface elevations for the selected events. Typical valley cross sections are presented to indicate ground levels and overlying flood depths across the valley. All data is based on conditions at the time of study (1986).

This report does not imply any federal authority to zone or regulate use of the flood plains; authority to zone and regulate rests with state or local governments. Technical data is provided for

1/ A flood which has a 1 percent chance of occurrence being equaled or exceeded in any year (also called "base" flood).

2/ A flood which has a 0.2 percent chance of occurrence being equaled or exceeded in any year.

potential future adoption of local land use controls to regulate flood plain development. Since this report identifies flood problems it will give guidance to development, with environmental considerations, of flood damage reduction techniques such as flood control structures, removal of obstructions and flood proofing for use in an overall Flood Plain Management Program.

The assistance and cooperation of the City of Edgeley, LaMoure County Water Resource District, West LaMoure County Soil Conservation District, North Dakota State Water Commission and private citizens in carrying out this study are appreciated.

FLOOD PLAIN MANAGEMENT STUDY
IN THE VICINITY OF EDGELEY

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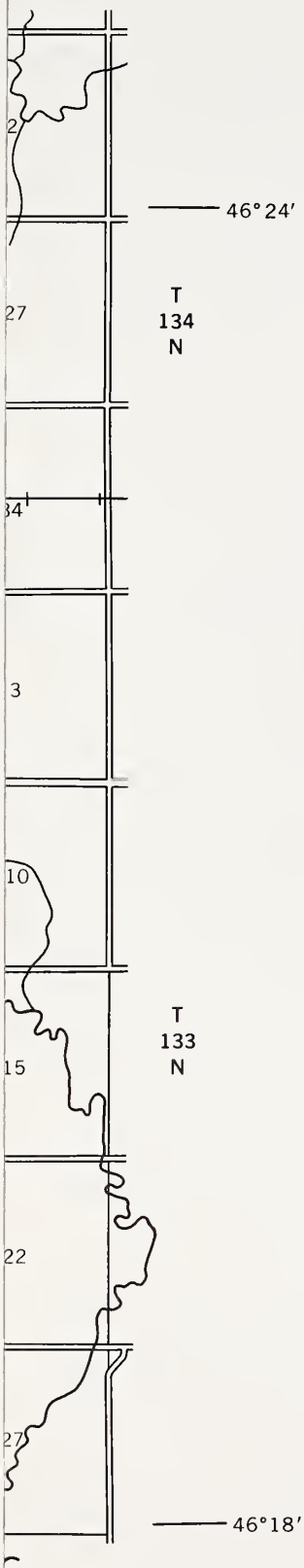
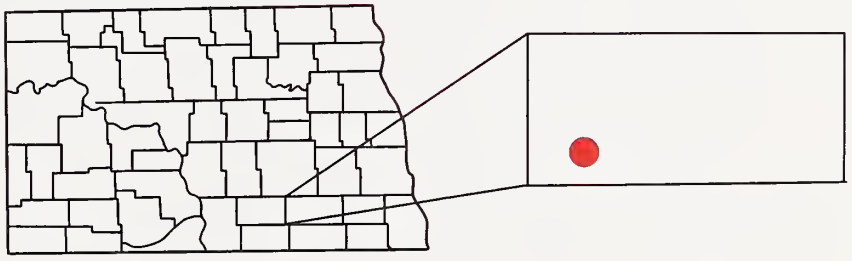


LEGEND

- TOWN
- 281 FEDERAL HIGHWAY
- 13 STATE HIGHWAY
- RAILROAD
- DRAINAGE
- STREAM REACH STUDIED



VICINITY MAP

VICINITY MAP

EDGELEY

FLOOD PLAIN MANAGEMENT STUDY

LA MOURE COUNTY, NORTH DAKOTA

0 1 2
MILES

0 1 2
KILOMETERS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

98°48′

98°36′

46°24′

46°18′

T 134 N

T 133 N

R 64 W

R 63 W

EDGELEY

MAPLE

MAPLE CREEK

BURLINGTON N. R.R.

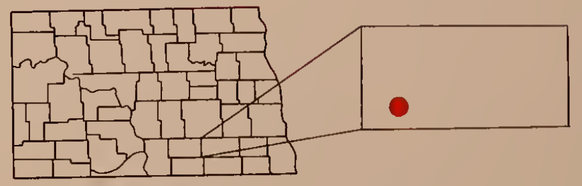
NORTHERN RAILROAD

RIVER

N

LEGEND

- TOWN
- FEDERAL HIGHWAY
- STATE HIGHWAY
- RAILROAD
- DRAINAGE
- STREAM REACH STUDIED



VICINITY MAP

VICINITY MAP

EDGELEY

FLOOD PLAIN MANAGEMENT STUDY

LA MOURE COUNTY, NORTH DAKOTA

0 1 2 MILES

0 1 2 KILOMETERS

SOURCE
1982 GENERAL HIGHWAY MAP AND
INFORMATION FROM SCS FIELD PERSONNEL
LAMBERT CONFORMAL CONIC PROJECTION

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX -1987

MARCH 1985 4-R 40077

INTRODUCTION

The purpose of this cooperative study is to identify flood hazard areas in and adjacent to the city of Edgeley, North Dakota, and provide technical data necessary to implement an effective local flood plain management program. Competition for land is increasing pressure to develop flood plain areas. Increasing land values and scarcity of undeveloped areas in which to expand often results in flood plain encroachment. Flood plain encroachment frequently results in reduced flood conveyance causing increased flood stages and overall flood losses.

With federal laws governing financing within flood plains, many financial institutions are reluctant to lend unless there is assurance that the area is flood free or can be protected. Federal agencies cannot finance projects in unprotected flood prone areas.

It is imperative that flood plains in agricultural areas be defined for the planning and location of farmsteads and to identify those areas where flood control measures can be applied.

This flood hazard study was requested by the LaMoure County Water Resource District and the West LaMoure County Soil Conservation District, through the North Dakota State Water Commission, under the 1978 Joint Coordination Agreement with the Soil Conservation Service. Priorities regarding such studies are set by the North Dakota State Water Commission. The study authority is in accordance with the April 1985 Plan of Study between the LaMoure County Water Resource District, West LaMoure County Soil Conservation District, the North Dakota State Water Commission and the Soil Conservation Service.

The study begins at designated river mile 1.32 (mile 0.0 = confluence with Maple River), located approximately 1 mile east of Edgeley on North Dakota Highway 13 between Sections 2 and 11. It proceeds upstream along the unnamed tributary of the Maple River to river mile 5.36, about ½ mile west of Edgeley near the center of Section 4. Three branches to the unnamed tributary were also studied and their channel lengths are: Branch 1 - 1.04 miles, Branch 2 - 0.99 miles, and Branch 3 - 0.57 miles. Within the study area a total of 6.64 miles of stream channel were investigated.

The "Extra Territorial Jurisdiction Law", passed by the 1975 North Dakota Legislature, provides communities authority to zone outside the corporate limits. The 1981 North Dakota Legislature amended and re-enacted the law to include each quarter-quarter section within one-half mile of the corporate limits for incorporated cities with a population of 5,000 or less. The extra territorial jurisdiction for the city of Edgeley is covered by this study.

Flood plain management studies carried out by the Soil Conservation Service result from recommendations found in A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress, second session), Recommendation 9(c), "Regulation of Land Use".

SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management", and Section 6 of Public Law 83-566. The principles contained in Executive Order 11988, Flood Plain Management, directs that "all executive agencies responsible for programs which

entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved."

Potential users of flood plains should base planning decisions upon the advantages and disadvantages of each location. Potential flood hazards are often unknown and consequently the managers, potential users, and occupants cannot always accurately assess these risks. In order for a local flood plain management program to be effective in the planning, development and use of flood plains, technical expertise is needed to collect, evaluate and interpret flood hazard data to help establish local flood plain management programs. SCS will:

1. Assist the state and local units of government by preparing appropriate technical information and interpretations for use in their flood plain management programs.

2. Provide technical services to managers of flood plain property for community, industrial and agricultural uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and organizations.

This report contains aerial photomaps, water surface profiles and typical valley and channel cross sections indicating the extent of flooding which can be expected in the study area. The 10-, 50-, 100- and 500-year frequency flood discharges and elevations are included.

The North Dakota State Water Commission or the Soil Conservation Service will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information developed in this study.

STUDY AREA DESCRIPTION

The study area is located in the Water Resource Council's Missouri Region and Subregion 10160004.

The climate in the study area is the continental type, typical of the Northern Great Plains. The temperature fluctuates over a wide range with a mean annual temperature of about 41.4° F, and recorded extremes of -41° F and +116° F. The mean temperatures for January and July are 8.9° F and 70.6° F respectively. The average annual precipitation for the area is about 17.6 inches. About 70 percent of the total annual precipitation occurs throughout the 120 day average growing season. Average dates for the first and last killing frosts are September 18 and May 20.

The city of Edgeley is located near the western edge of the glaciated plains of the Central Lowland Physiographic Province of North Dakota.

The area was glaciated during the Pleistocene Epoch and the land forms are largely the result of glacial and post-glacial processes. The topography is gently undulating to undulating with poorly integrated drainage. The glacial till sediment is an unbedded, unsorted mixture of clay, silt, sand, pebbles and a few cobbles and boulders.

The eastward flowing ephemeral tributaries have their source in the glacial till uplands immediately west of the city. As they enter the west edge of the city, they merge and turn in a northerly direction paralleling the Burlington Northern Railroad. At the north side of Sec. 3, T.133N., R.64W., the channel goes through the railroad grade and begins a southeasterly course. Here the tributary

flows in a glacial meltwater channel for about 3 miles where it joins the Maple River. At approximately river mile 2.42, overflows occur from the unnamed tributary and flow in a southeasterly direction through a swale area. Discharges through this overflow area range from 10 cfs at the 50-year frequency to 36 cfs at the 500-year frequency, respectively. These flows do not re-enter the unnamed tributary within the study area. See sheets 8-10, Appendix A, for pictorial description.

NATURAL VALUES

"Flood plains including their land and water ecosystems, have evolved from natural forces over tens of thousands of years. Yet, after two centuries of our Nation's history, the natural values of most of our flood plains have been significantly altered. Thus, there is a national concern to carefully manage the remaining natural values of flood plains."[1/]

The Edgeley Flood Plain Management study consists of the flood plains and similar adjacent resource areas. The natural values discussion includes nearly three miles of stream channel and adjacent areas in the study area, which includes the east half of Section 4, all of Sections 2 and 3, the northwest quarter of Section 10, and approximately 5 acres in the south central edge of Section 34.

Within the study area, approximately 31 percent is considered prime farmland, 4 percent is considered prime farmland where drained, 56 percent is additional farmland of statewide importance, less than 1 percent is additional farmland of local importance, 8 percent is other nondesignated categories.

There are approximately 61 acres of wetlands, types 1, 3 and 4 primarily occurring in soils map units Saline land (Sa), Barnes-Cresbard loams (Bc) and Barnes-Svea loams, undulating (BnB). There are very few scattered wooded areas, most of which have been planted, occurring in the study area. The wetlands and woodlands provide habitat for various wildlife species using the flood plain and adjacent areas including: deer, fox, mink, raccoon, jack rabbit,

1/ "A Unified National Program for Flood Plain Management," March 1986, Federal Emergency Management Agency, Interagency Task Force on Flood Plain Management.

pheasant, partridge, ducks, geese, doves, numerous song birds and other nongame species. Some of the woody species include green ash, cottonwood, willow, chokecherry, Russian olive and elm.

Naturally occurring beneficial flood plain values in the study area have been significantly affected by human actions. These actions have removed conditions under which natural processes can continue. Some of those actions include wetland destruction, paving, roofing, deep foundations, buildings, roads, dikes and dams, as well as, fertilizers, chemical and petroleum spills and leached products of waste disposal areas.

Flood plains in their natural or relatively undisturbed state provide three sets of natural and beneficial resources and hence resource values: (1) water resource values including natural moderation of floods, water quality maintenance, and groundwater recharge; (2) living resource values including large and diverse populations of plants and animals; and (3) cultural resource values including historical, archeological, scientific, recreational, and esthetic sites.2/

Flood plain natural values management and re-establishment should be considered in the study area. The following examples of practices would be beneficial to flood plain values:

1. Minimize filling in the flood plain.
2. Relocate structures out of the flood plain.
3. Restore and preserve natural drainage routes.
4. Restore damaged wetlands and prevent additional wetland destruction and channelization.

2/ "A Unified National Program for Flood Plain Management," March 1986, Federal Emergency Management Agency, Interagency Task Force on Flood Plain Management.

5. Support agricultural and urban practices that minimize water quality degradation, such as controlled use of pesticides, herbicides and fertilizers.

6. Limit field size. Promote fence rows, field windbreaks and stripcropping.

7. Design structural upstream projects for runoff detention.

8. Re-establish damaged flood plain ecosystems.

9. Maintain existing riparian vegetation as a green belt.

The study area is not presently, nor is it proposed to be, listed in the National Wild and Scenic Rivers System. No critical habitats for threatened or endangered species were identified in the study area. The 1978 Stream Evaluation Map - State of North Dakota does not classify this stream reach as a high-priority fishery resource.

Cultural resource impacts have often been overlooked, especially those resulting from flood plain development and modification. Historical, archeological and scientific, as well as esthetic sites, are often degraded or destroyed by accelerated runoff, blocked runoff, interrupted groundwater flow and increased pollution loadings. Poor agricultural land use practices can be just as destructive of flood plain values as the more obvious structural forms of development.3/

Cultural resource information obtained from the State Historical Society indicates no sites have been identified within the study area. The lack of identified sites in this area reflects the lack of archeological field investigations rather than a lack of past human settlement.

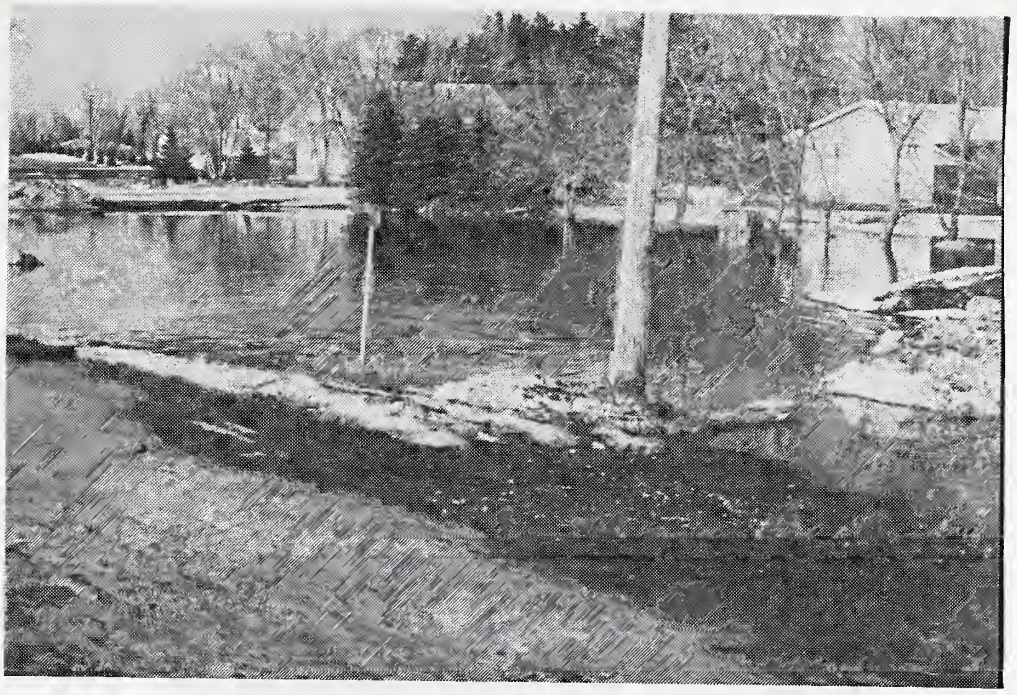
3/ "A Unified National Program for Flood Plain Management," March 1986, Federal Emergency Management Agency, Interagency Task Force on Flood Plain Management.

FLOOD PROBLEMS

Edgeley has experienced a flood problem every year since 1978. The problem has been getting worse, with the highest flood waters reported in the spring of 1982. Large floods can occur from spring snowmelt runoff due to winter accumulation of snow and frozen soil conditions. The watershed configuration is such that floodwaters from the individual drainages converge nearly simultaneously in Edgeley, causing relatively high discharges and flood stages for both snowmelt and rainfall events. Duration of flooding is short, with most events peaking and then receding within a few hours.

The following photographs illustrate typical flood depths through Edgeley.

Spring 1984 (Photo courtesy of Roger Pauling)



Spring 1984 (Photo courtesy of Roger Pauling)

Potential flood areas within the study area include residential, commercial, transportation, and agricultural land. Flood damages include eroded land, sediment deposition, crop damage, residence and commercial property damage, and weakened roads and bridges.

Upland agricultural drainage, restrictive culverts and bridges, and limited channel capacity contribute to the severity of flooding within the study area.

A 500-year frequency flood within the study area will inundate approximately 340 acres. A 100-year frequency flood will inundate approximately 270 acres.

Note shallow flow and backwater condition.

Spring 1979 (Photo courtesy of Mike Cuypers)

Spring 1979 (Photo courtesy of Mike Cuypers)

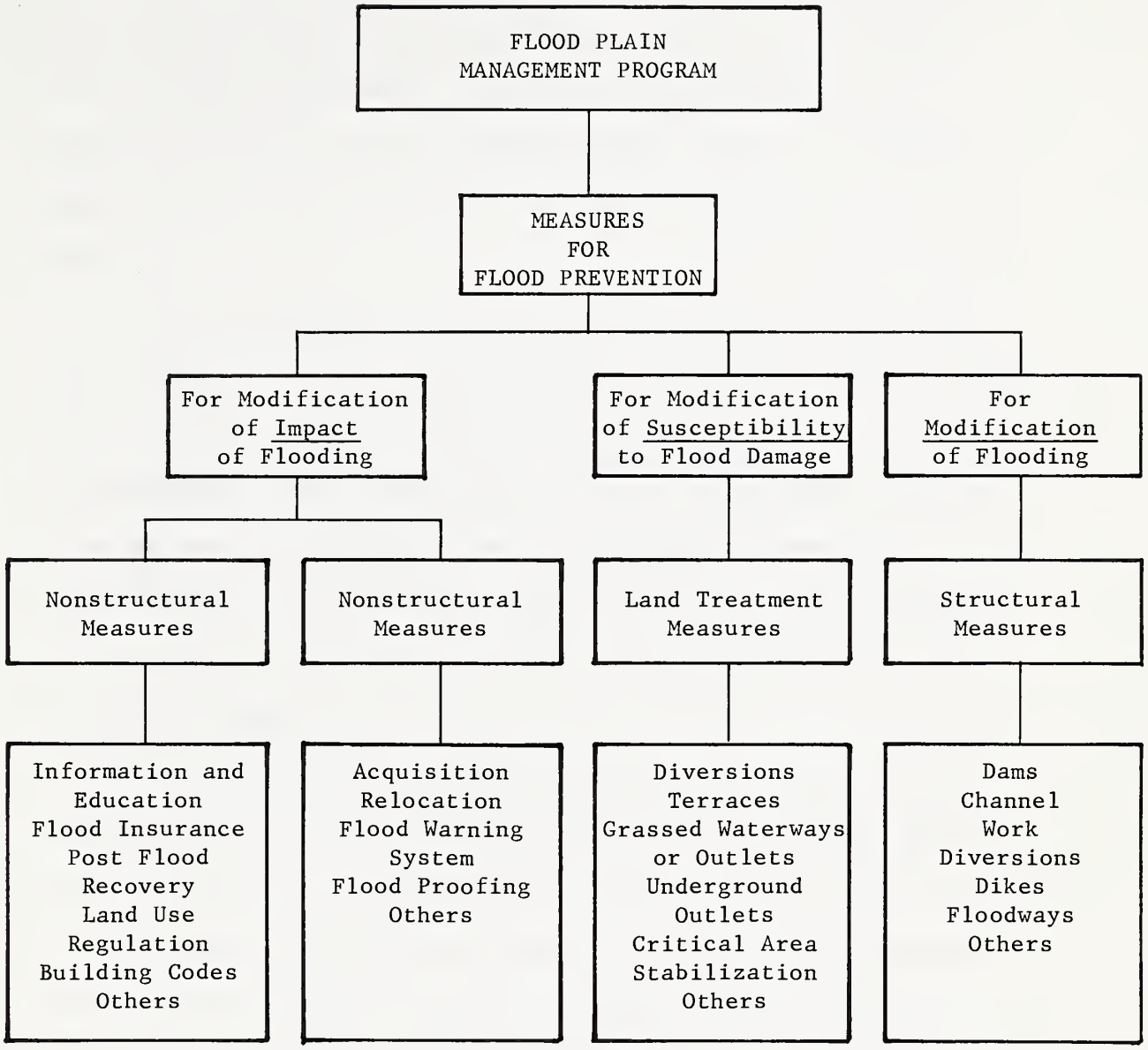
EXISTING FLOOD PLAIN MANAGEMENT

Due to the lack of flood hazard information, existing flood plain management is essentially limited to administrative actions such as participation in the National Flood Insurance Program (NFIP).

Under the National Flood Insurance Act of 1968 (PL 90-448), the Federal Emergency Management Agency (FEMA), Federal Insurance Administration (FIA), is authorized to carry out a National Flood Insurance Program (NFIP). This program makes flood insurance coverage available to all walled and roofed structures and their contents used for residential, business or nonprofit, religious, agricultural and governmental purposes. In participating areas, owners and occupiers of all buildings and mobile homes are eligible to obtain flood insurance coverage. The study area is currently eligible to participate in the emergency phase National Flood Insurance Program.

ALTERNATIVES FOR FLOOD PLAIN MANAGEMENT

A viable local flood plain management program is comprised of numerous elements. As shown in the following flow chart, these include land treatment, nonstructural, and structural measures to modify the susceptibility to flood damages and the impact of flooding. Land treatment and structural measures reduce flood losses by modifying flooding. Land treatment measures include such things as diversions, terraces, and water and sediment control basins. Structural measures include such things as channel work, dikes, or floodwater retarding dams. Nonstructural measures alleviate flood losses by modifying the susceptibility of land, people, and property to flood damage or by modifying the impact of flooding. Nonstructural measures consist of administrative actions such as zoning, building codes, or flood insurance; relocation (repositioning) of existing flood plain properties to flood free areas; flood plain acquisition; floodproofing; and flood warning systems.


FLOOD PLAIN
MANAGEMENT PROGRAM
MEASURES
FOR
FLOOD PREVENTION
For Modification
of Impact
of Flooding
For Modification
of Susceptibility
to Flood Damage
For
Modification
of Flooding
Nonstructural
Measures
Nonstructural
Measures
Land Treatment
Measures
Structural
Measures
Information and
Education
Flood Insurance
Post Flood
Recovery
Land Use
Regulation
Building Codes
Others
Acquisition
Relocation
Flood Warning
System
Flood Proofing
Others
Diversions
Terraces
Grassed Waterways
or Outlets
Underground
Outlets
Critical Area
Stabilization
Others
Dams
Channel
Work
Diversions
Dikes
Floodways
Others

The key to a viable local flood plain management program is detailed flood hazard information.

With flood hazard information, the community can minimize future flood losses by planning for the protection of existing structures within the flood plain area. Overall planning strategies for industrial, commercial and residential areas, streets, utilities, parks, and schools must recognize the need to develop outside the flood plain.

A coordinated planning procedure such as this is a vital part of any comprehensive flood plain management program. Effective flood plain management involves public policy and action for the wise use and development of the flood plain. It also includes such measures as collection and dissemination of flood control information, acquisition of flood plain lands, construction of control structures, and enactment of ordinances and statutes regarding flood plain land use and development.

Participation in the National Flood Insurance Program could be upgraded from the emergency phase to the regular program by adopting flood plain regulations that meet the Federal Insurance Administration's standards. These standards are based on a detailed flood insurance study. The data included in this flood plain management study is comparable to a detailed flood insurance study.

Further inquiries about the flood insurance program should be directed to the Office of the State Engineer, North Dakota State Water Commission, the official state coordinating agency for flood insurance.

Flood Control Measures

Land treatment measures that can be used to reduce downstream flooding include terraces, diversions, conservation cropping and tillage systems, stripcropping and similar measures.

Structural flood control measures that can be used to reduce the flooded area include enlarged bridge openings, dikes, floodwater retarding dams, floodways, open channels, or a combination of measures.

Floodproofing and Other Measures

In order for administrative actions such as land use and other regulatory controls such as zoning, subdivision regulations, and building codes to be effective, it is important that the community takes action to implement other programs and measures to supplement these controls.

A few possible measures to protect and control developments in flood prone areas are: (1) open space land acquisition programs, (2) urban renewal programs, (3) preferential tax assessment, (4) flood proofing of existing structures, and (5) public policy governing the construction of utilities and public facilities such as bridges and streets.

Floodproofing consists of modifications of existing structures, their sites, and building contents to reduce the probability and adverse effects of water entry. Floodproofing measures such as blocking off low level entrances and windows; elevating the building or contents above the expected base elevation; installing one-way valves, standpipes, or overhead sewer systems to prevent sewage backup; installing protective walls; and strengthening walls and foundations are usually cost-effective. The property owner is responsible for

the installation, operation, and maintenance of floodproofing measures. Generally, the installation of floodproofing measures requires a qualified contractor along with some technical assistance. For a guide, see Federal Emergency Management Agency publications; FEMA 114, "Design Manual for: Retrofitting Flood-prone Residential Structures", GPO 1986-624-366/732 and FEMA 102, "Floodproofing Non-Residential Structures", GPO 1986-6214-393/00128.

A local flood warning and response system could be an important means to mitigate flood losses. Community officials need to consider several factors when evaluating the feasibility of establishing a system. Due to the complexity of some of these factors, the evaluation process requires technical assistance. For a guide, see "Guidelines on Community Local Flood Warning and Response Systems", Hydrology Subcommittee of the Federal Interagency Advisory Committee, National Technical Information Service, Springfield, Virginia 22161.

The Office of the State Engineer, upon request, will provide assistance in flood proofing techniques, the implementation of a flood warning system and establishment of a local flood data collection program.

Some specific alternatives and/or recommendations for alleviating the flood situation within the study area are:

1. Adopt local land use and zoning regulations for all flood plain areas. The basic purpose of flood plain regulations is to control development on the flood plain consistent with nature's needs for conveyance of flood flows. It is suggested that the flood plain regulations conform to the guidelines developed by the Federal Emergency Management Agency.

2. Flood proof existing buildings that otherwise cannot be adequately protected. (See U.S. Army Corps of Engineers "Manual of Flood Proofing Regulations", EP 1165-2-314 and "Elevated Residential Structures Reducing Flood Damage Through Building Design: A Guide Manual", published by the Federal Insurance and Hazard Division, HUD).

3. Use as much of the flood hazard areas as possible for parks and other open space uses.

4. Increase flow areas to minimize restrictions. Examples of this would be enlarging bridge and culvert sizes, grading streets to provide maximum overflow area directly adjacent to the channel, channel enlargement where practicable and consistent with environmental concerns, and general cleanout as part of normal channel operation and maintenance.

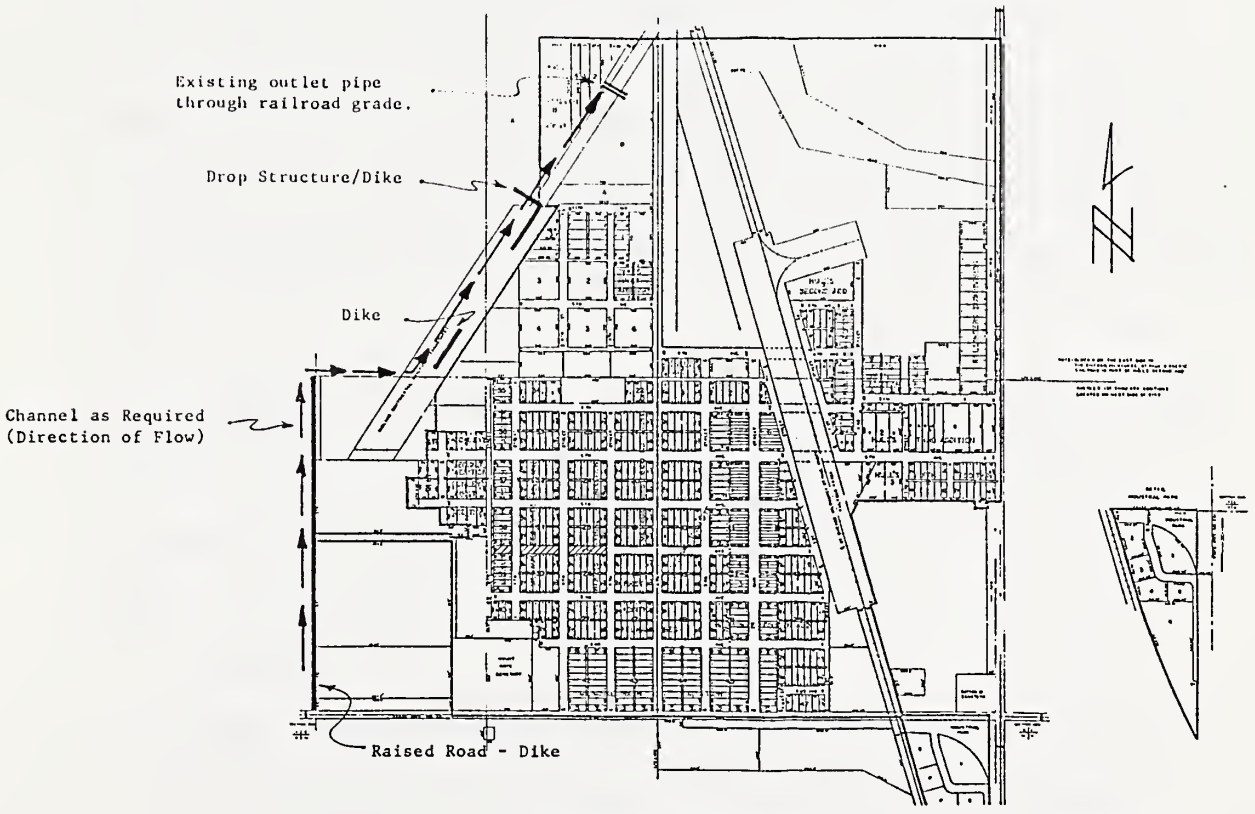
5. Divert water around Edgeley. An alternative utilizing the road west of Edgeley to store and divert floodwater was studied. The runoff from approximately 670 acres would be diverted north to the quarter line between Sections 3 and 4. The flow would pass east through the road to an abandoned railroad spur, parallel the spur to an existing pipe through the railroad, entering the existing watercourse downstream of Edgeley. Based on 100-year frequency protection and preliminary estimated cost of $82000 this alternative has a benefit/cost ratio of about 1 to 1 (for every dollar spent, a dollar benefit is realized).

6. Install land treatment practices in the upstream watershed. Flooding can be reduced equivalent to alternative 5 by a combination of diversions, terraces and water and sediment control basins. These

practices also reduce sediment by lowering the erosion rates on cropland. By reducing erosion and runoff, they will maintain or increase long term crop production. Costs and benefits of these practices will vary according to type of structure and location, but using average figures of $120/acre the system appears potentially feasible. A detailed analysis, based on landowner acceptance and specific desires, is beyond the scope of this study.

7. It is recommended that persons within or adjacent to the delineated flood hazard areas maintain flood insurance on both the structure and contents.

8. It is recommended that participation in the National Flood Insurance Program be upgraded from the emergency phase to the regular program.



DIVERSION (ALTERNATE 5) (Not to Scale)

G L O S S A R Y

Acre-Foot -- The amount of water that will cover one acre to a depth of one foot. Equals 43,560 cubic feet.

Backwater -- The resulting high water surface in a given stream due to a downstream restriction or high stages in an intersecting stream.

Channel -- A natural or artificial watercourse with definite bed and banks to confine and conduct continuously or periodically flowing water.

Cubic Feet Per Second -- Rate of fluid flow at which one cubic foot of fluid passes a measuring point in one second (cfs).

Discharge -- The rate of flow or volume per unit of time. In this report discharge is expressed in cubic feet per second (cfs).

Flood -- An overflow of water onto lands not normally covered by water. The inundation is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake or other body of standing water.

Flood Frequency -- An expression of how often a flood event of a given magnitude will, on the average, be equaled or exceeded. The word "frequency" often is omitted in discussing a flood event for the purpose of abbreviation.

"Examples"

10-year flood or 10-year frequency flood - the flood which can be expected to be equaled or exceeded on an average of once in 10 years, and which would have a 10 percent chance of being equaled or exceeded in any given year.

50-year flood - ...two percent chance...in any given year.

100-year flood - ...one percent chance...in any given year.

500-year flood - ...two-tenths of one percent chance...in any given year.

Flood Peak or Peak Discharge -- The highest stage or discharge attained during a flood.

Flood Plain, Flood Prone Area or Flood Hazard Area -- Land adjoining a stream (or other body of water) which may be temporarily covered by flood water.

Flood Plain Encroachment -- Placement of fill or structures in the flood plain which may impede flood flow and cause backwater.

Flood Proofing -- A combination of structural provisions, changes or adjustments to properties and structures subject to flooding for the reduction or elimination of flood damage to properties, water and sanitary facilities, structures and contents of buildings in a flood hazard area.

Flood Routing -- Computation of the changes in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

Flood Stage -- The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area.

Hydrograph -- A plotted curve showing the rise and fall of flood discharge with respect to time at a specific point on a stream.

Natural Storage Area -- In this report, refers to depressional areas, marshes, lakes and swamps that temporarily store a portion of the surface runoff.

Natural Values -- Values existing in an area undisturbed by the influence of civilization and society.

Riparian Land -- Land situated along the bank of a stream or other body of water.

Runoff -- In this report, refers to the portion of precipitation (including snowmelt) that flows across the land surface and contributes to stream or flood flow.

Stage Discharge Curve -- A plotted curve showing the variation of discharge with water surface elevation at a point on a stream.

Stage-Storage Curve -- A plotted curve showing the accumulated storage available for floodwater upstream from a point on a stream versus the stage at that point.

Valley Cross Section -- The relationship of the elevation of the ground to the horizontal distance across a valley perpendicular to the direction of flow.

Watershed -- A drainage basin or area which collects and transmits runoff to the outlet of the basin.

Watershed Boundary or Drainage Boundary -- The divide separating one watershed from another.

Water Surface Profile -- The relationship of water surface elevation to stream channel elevation at points along a stream, generally drawn to show the water surface elevation for the peak of a specific flood, but may be prepared for conditions at any given time.

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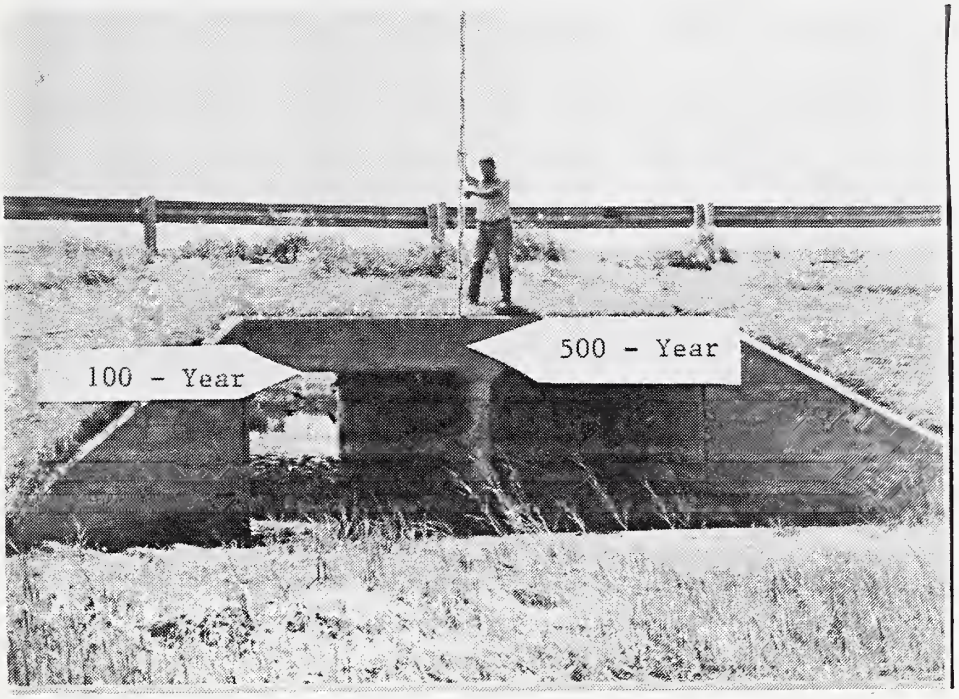


FIGURE 2 - M1.32, Box Culvert (Highway 13)
Between Sections 2 and 11, T. 133 N., R. 64 W.

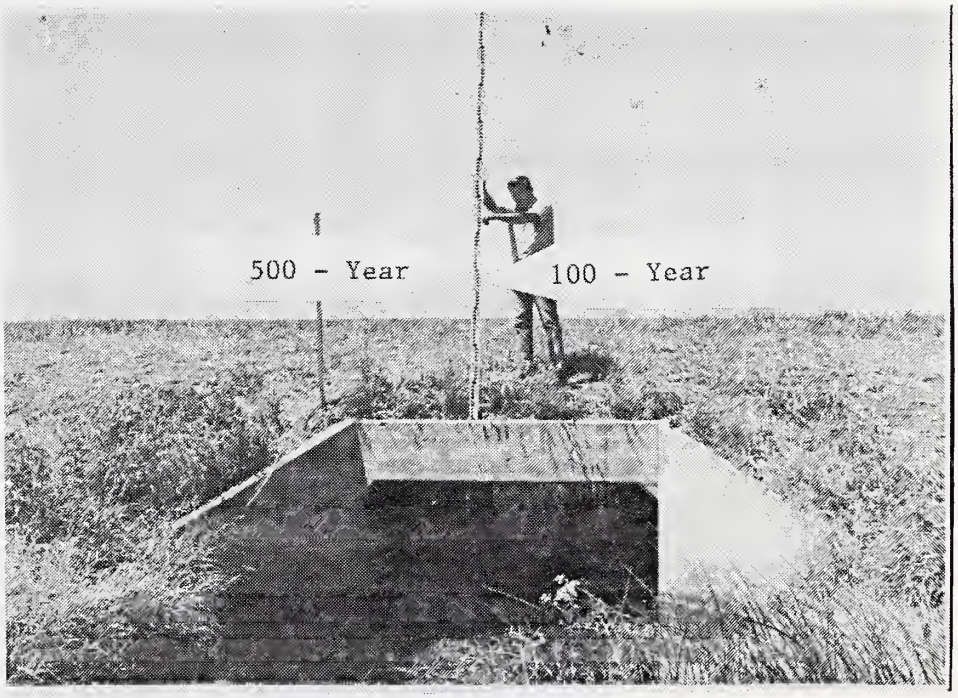


FIGURE 3 - M2.72, Box Culvert (Highway 281)
Between Sections 2 and 3, T. 133 N., R. 64 W.

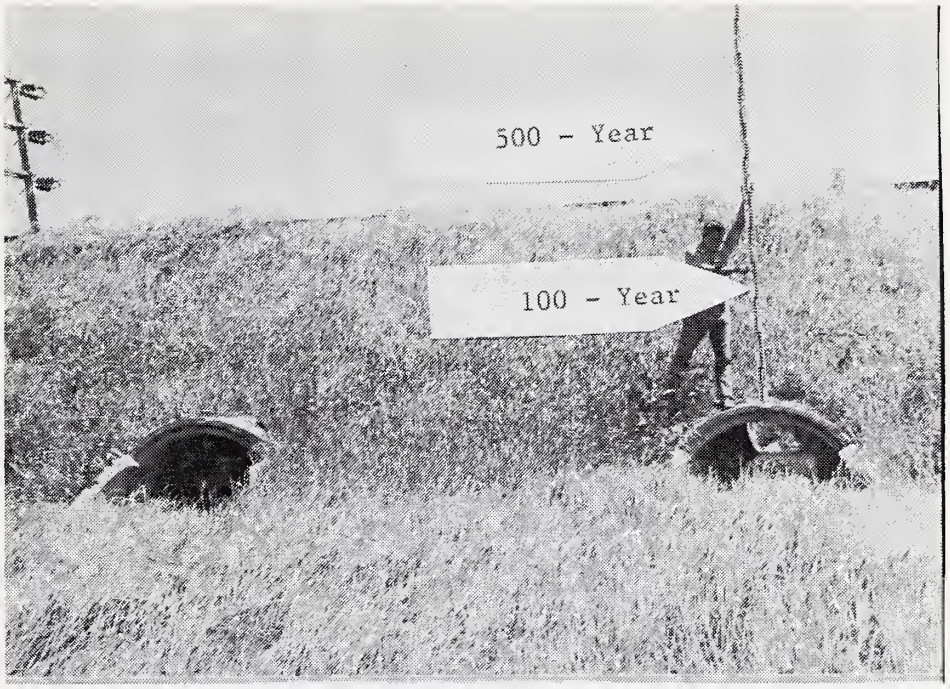


FIGURE 4 - M3.25, Railroad RCP
NE¼ Section 3, T. 133 N., R. 64 W.

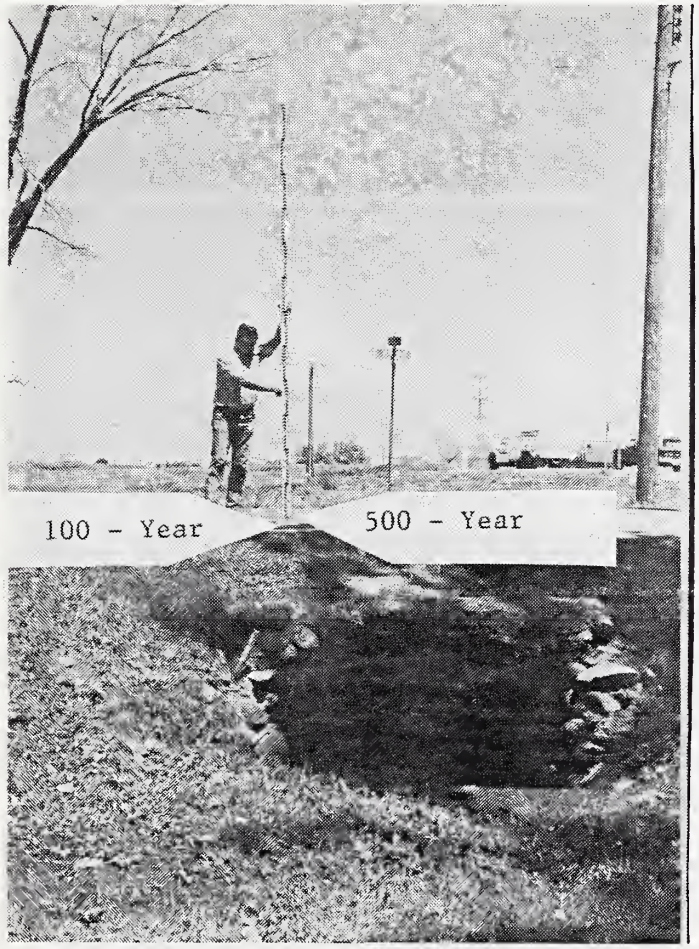


FIGURE 5 - M3.78, Box Culvert, 8th Ave. and Main St. SE¼ Section 3, T. 133 N., R. 64 W.

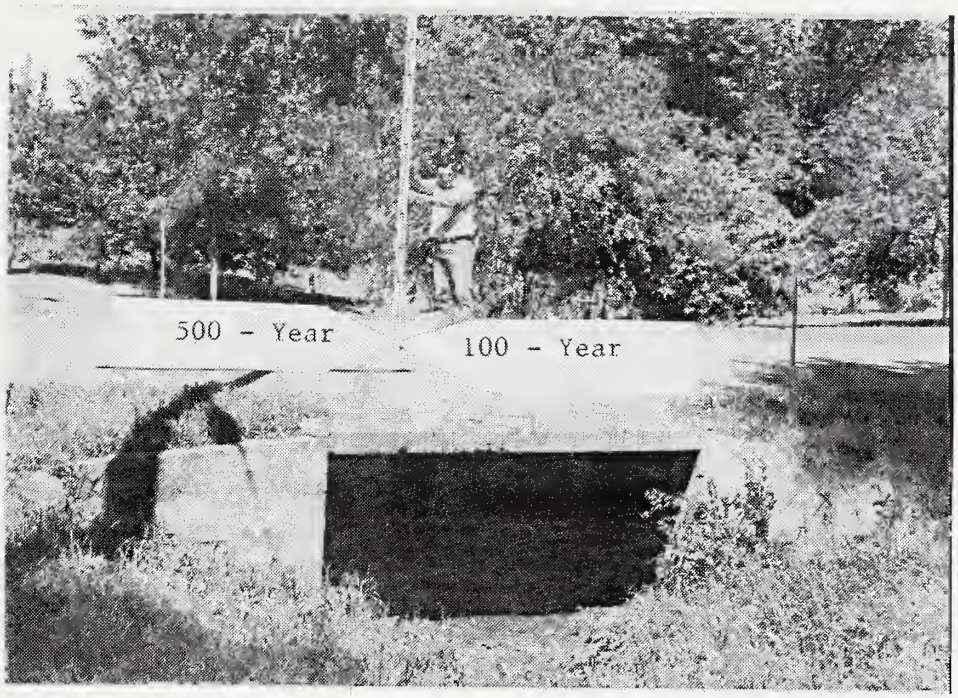


FIGURE 6 - M3.86, Box Culvert, 3rd Street
SE¼ Section 3, T. 133 N., R. 64 W.

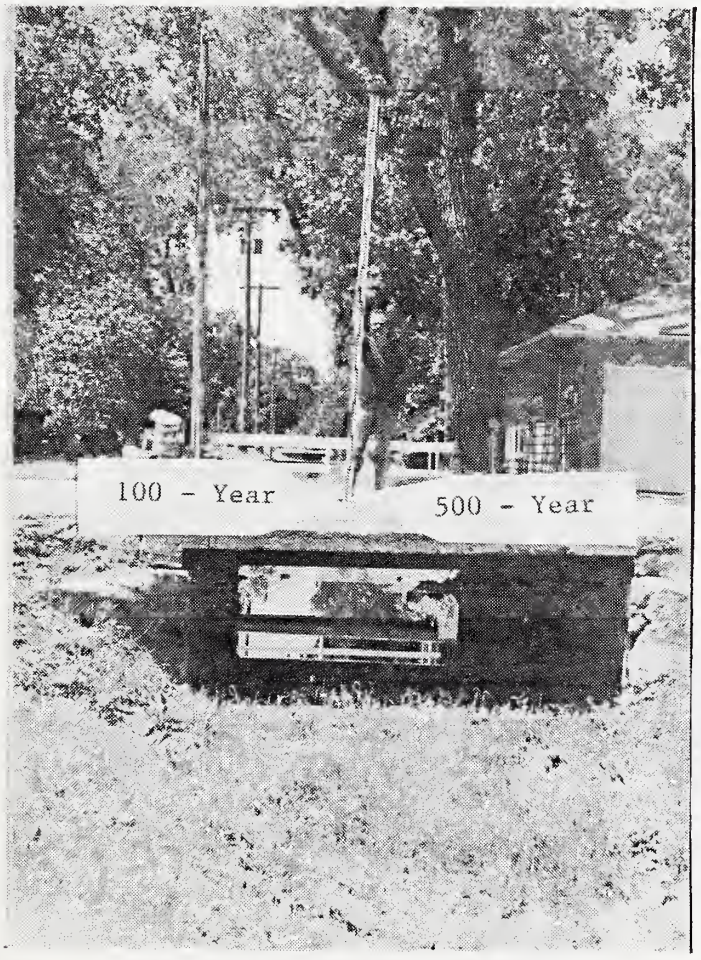


FIGURE 7 - M3.93, Box Culvert, 4th Street.
SE¼ Section 3, T. 133 N., R. 64 W.

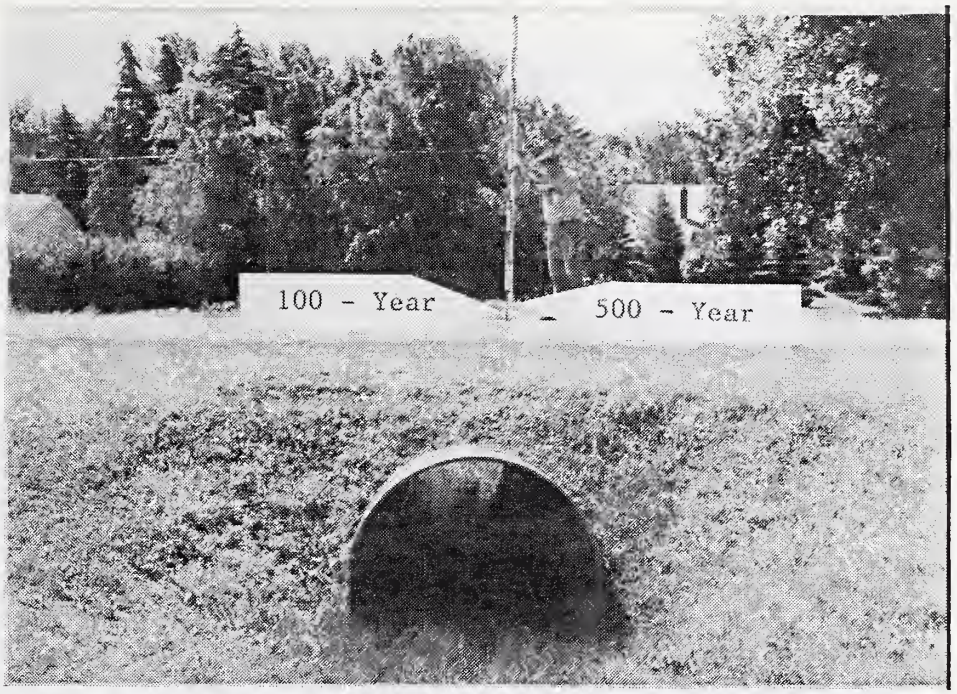


FIGURE 8 - M4.15, C.M.P., 7th Ave.
SE¼ Section 3, T. 133 N., R. 64 W.

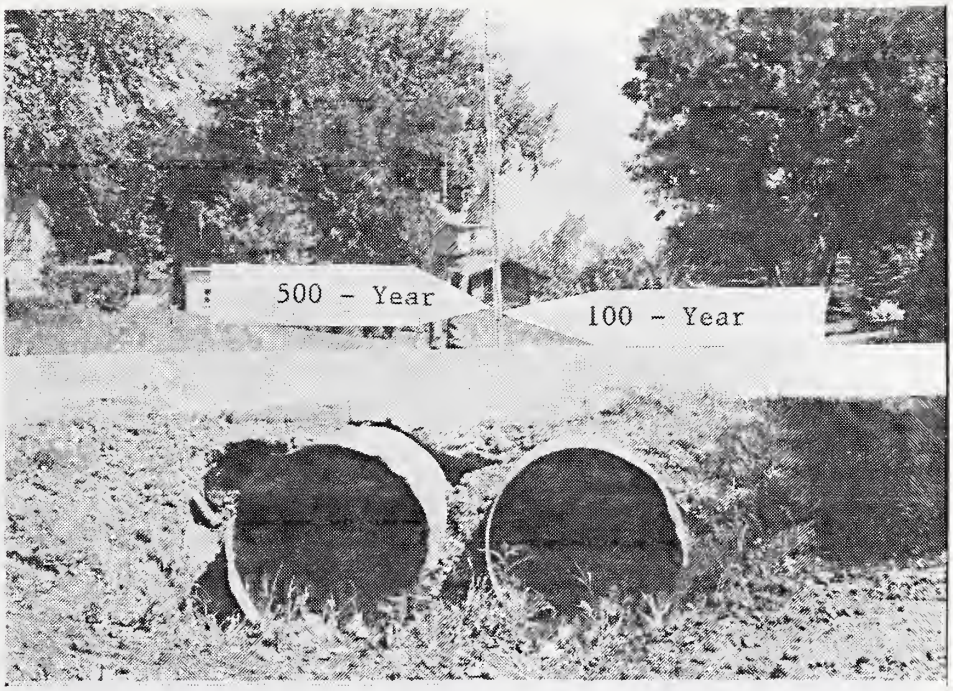


FIGURE 9 - M4.22, C.M.P., 6th Ave.
SE¼ Section 3, T. 133 N., R. 64 W.

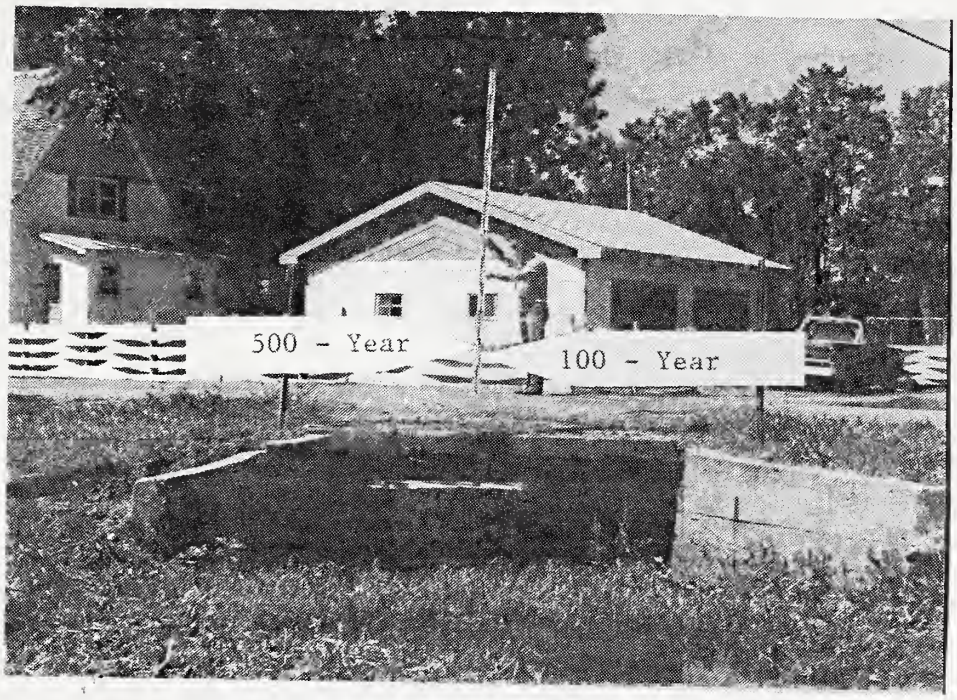


FIGURE 10 - M4.26, Box Culvert, 6th Street
SE¼ Section 3, T. 133 N., R. 64 W.

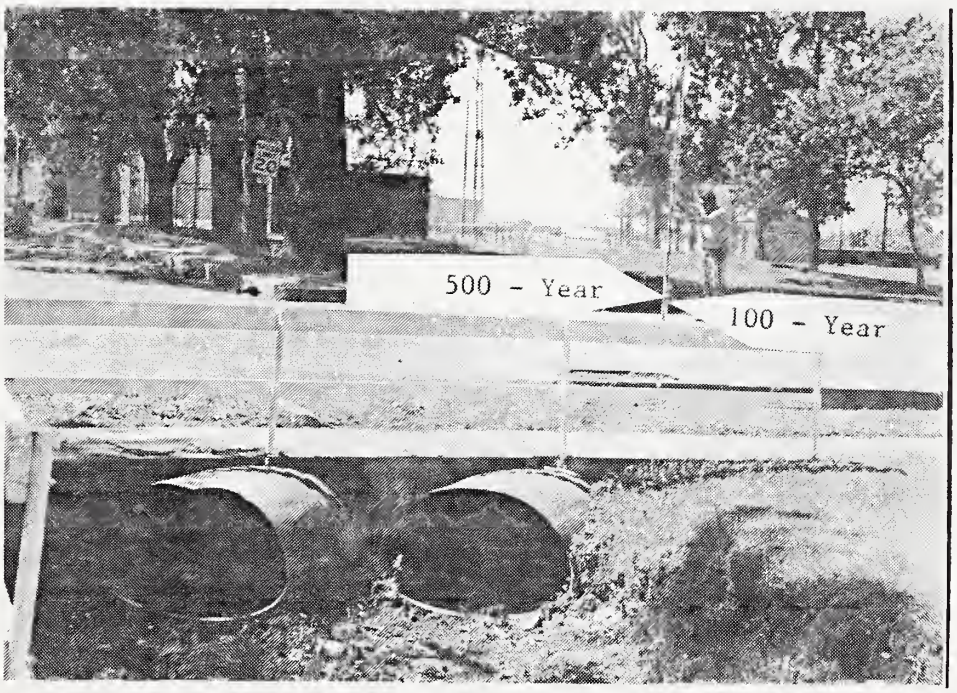


FIGURE 11 - M4.31, C.M.P., 5th Avenue
SE¼ Section 3, T. 133 N., R. 64 W.

APPENDIX A

FLOOD HAZARD AREA PHOTOMAPS

Ten photomaps are included to show flooded area for the 100 and 500 year flood events.

The photomaps should be useful to visually check the approximate areas flooded between valley sections.

LEGEND

10 SHEET COVERAGE

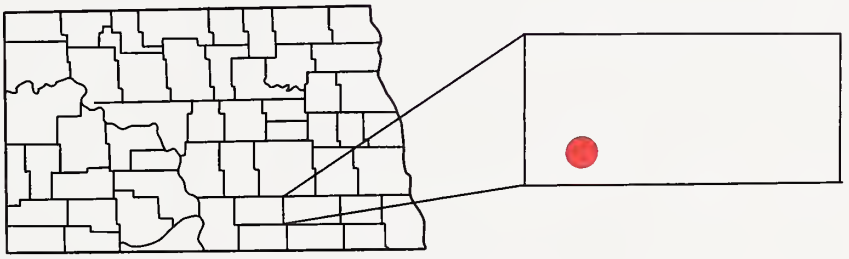
FLOOD PLAIN AREA (100 AND 500 YEAR FREQUENCY FLOODS)

STREAM CHANNEL

T
134
N

T
133
N

N



VICINITY MAP

INDEX TO MAP SHEETS

EDGELEY

FLOOD PLAIN MANAGEMENT STUDY

LA MOURE COUNTY, NORTH DAKOTA

0 1

MILES

0 1

KILOMETERS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

R 64 W

T 134 N

T 133 N

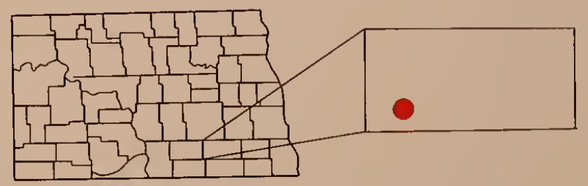
LEGEND

10 SHEET COVERAGE

FLOOD PLAIN AREA (100 AND 500 YEAR FREQUENCY FLOODS)

STREAM CHANNEL

N



VICINITY MAP

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LA MOURE COUNTY, NORTH DAKOTA

0 1 MILES

0 1 KILOMETERS

SOURCE
OCTOBER 1985 AERIAL PHOTOGRAPHY FROM KBM, INC
AND INFORMATION FROM SCS FIELD PERSONNEL

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100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 4.46 VALLEY SECTION

1589 ESTIMATED 100-YEAR FLOOD ELEVATION

BnB SOILS AREA AND SYMBOL

SCALE 0 200 400 FEET
0 50 100 METERS
APPROXIMATE

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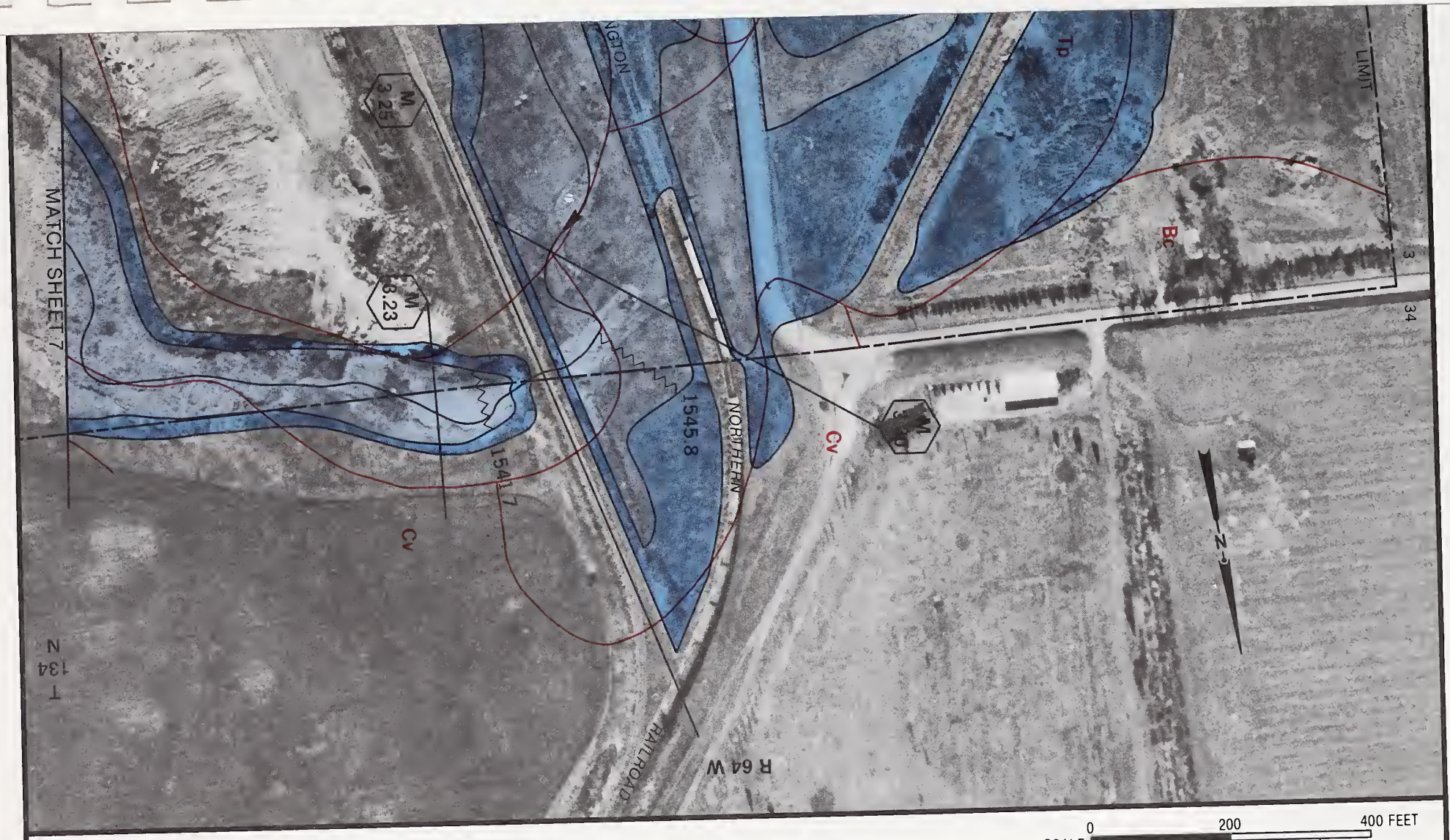

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 4.46 VALLEY SECTION

1589 ESTIMATED 100-YEAR FLOOD ELEVATION

BnB SOILS AREA AND SYMBOL

SCALE 0 200 400 FEET
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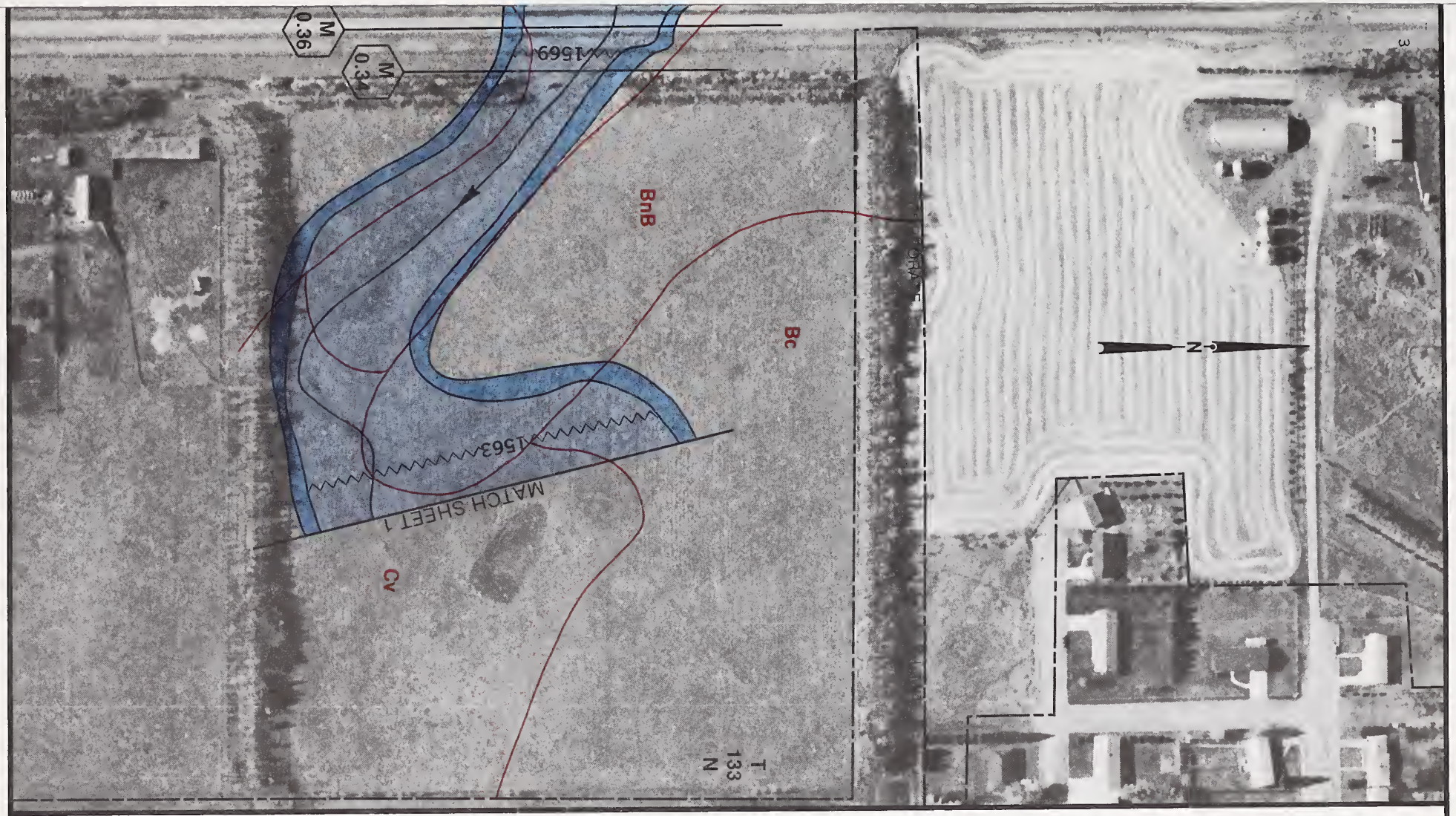

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

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BRANCH 2

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END OF STUDY

M 0.98

1589

1580

BRANCH 2

1571

1569

1563

M 0.38

M 0.36

M 0.3

Bc

Tp

BnB

MATCH SHEET 1

R 64 W

T 133 N

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 4.46 VALLEY SECTION

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100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

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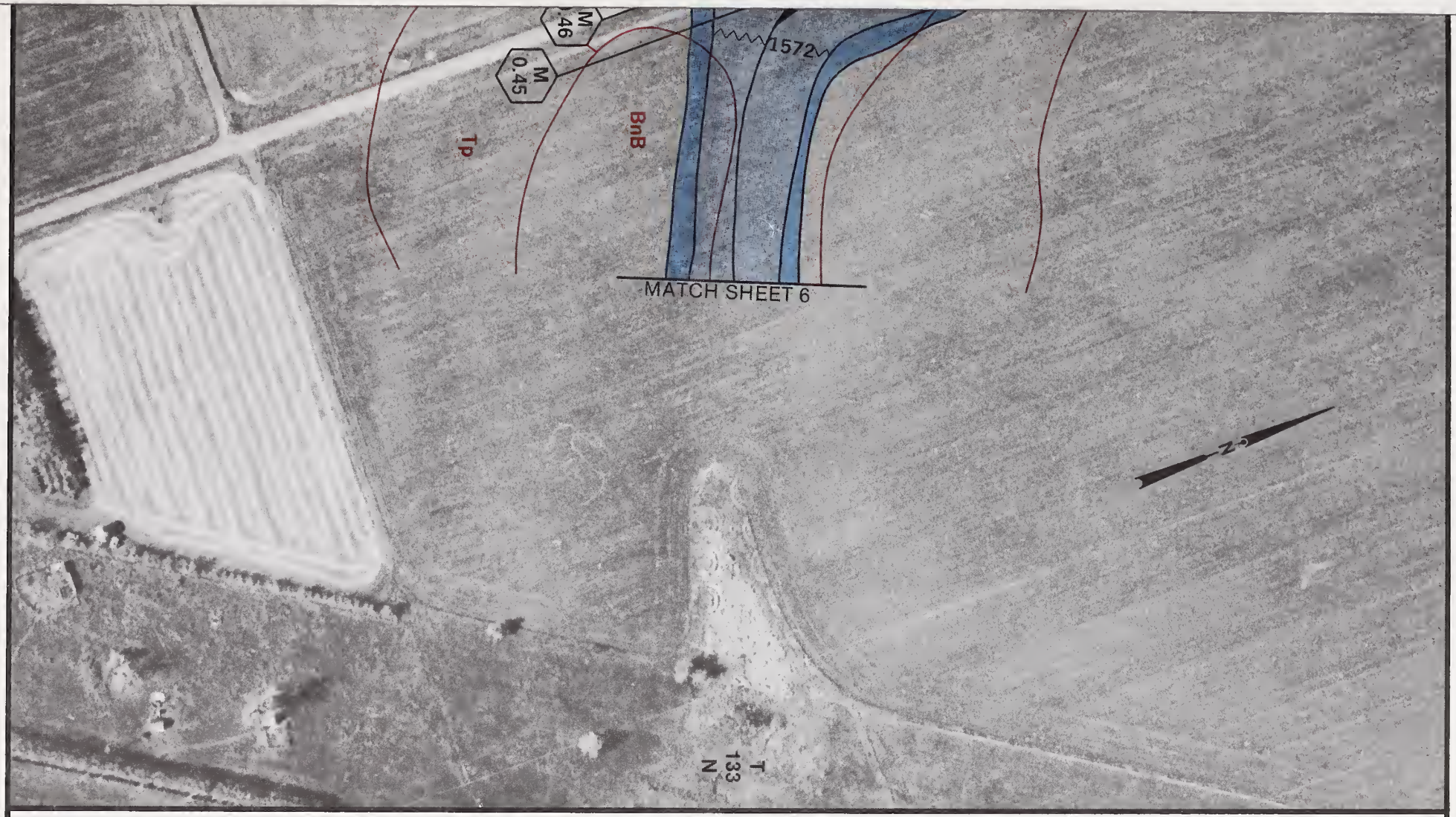

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

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END OF STUDY

1580.6

M 1.03

1580

M 0.69

1579

BRANCH 1

1576

1574.3

M 0.48

M 0.46

M 0.45

1572

BnB

Bc

Tp

MATCH SHEET 6

R 64 W

T 133 N

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 4.46 VALLEY SECTION

1589 ESTIMATED 100-YEAR FLOOD ELEVATION

BnB SOILS AREA AND SYMBOL

SCALE 0 200 400 FEET

0 50 100 METERS

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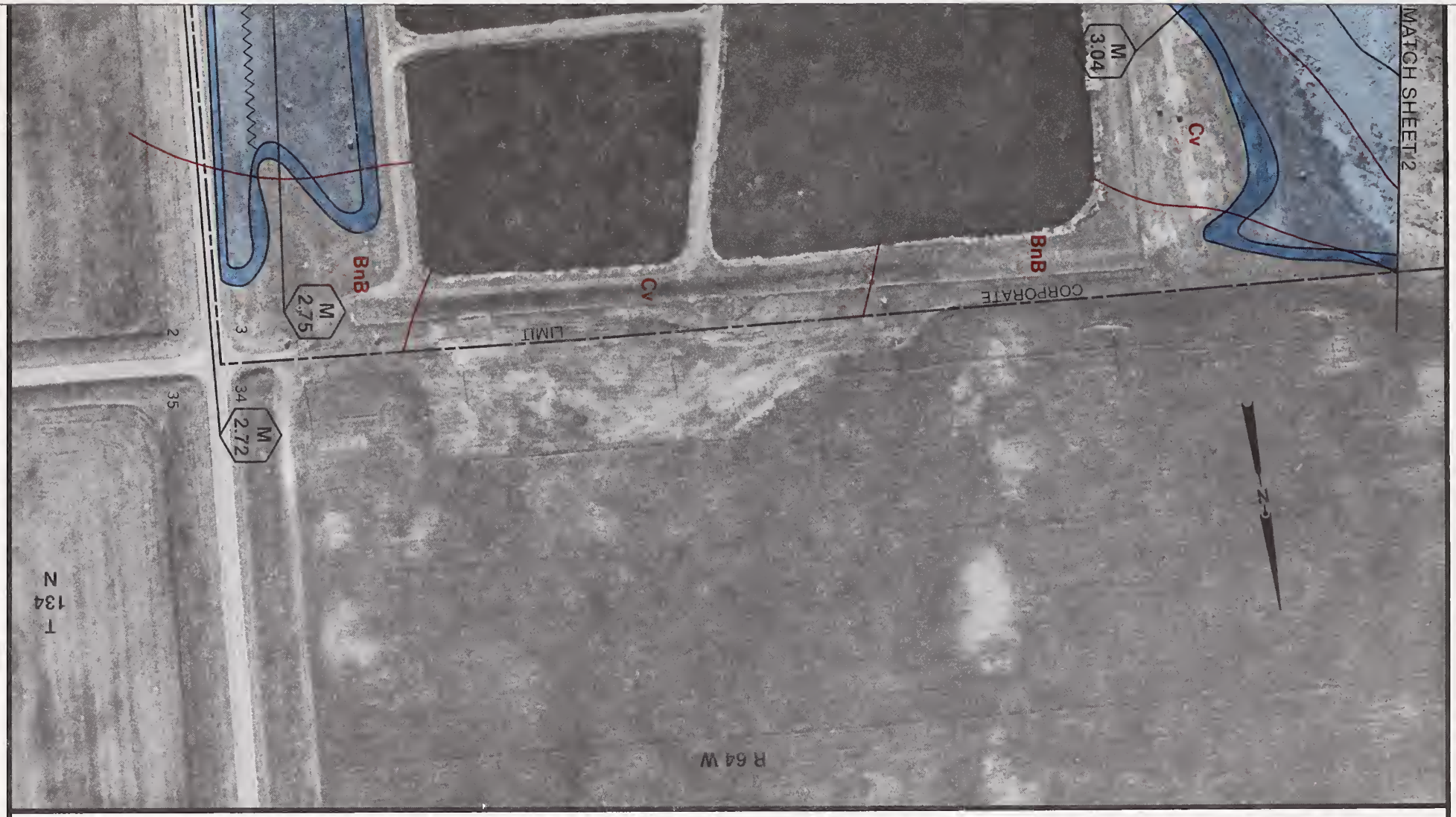

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STREAM CHANNEL

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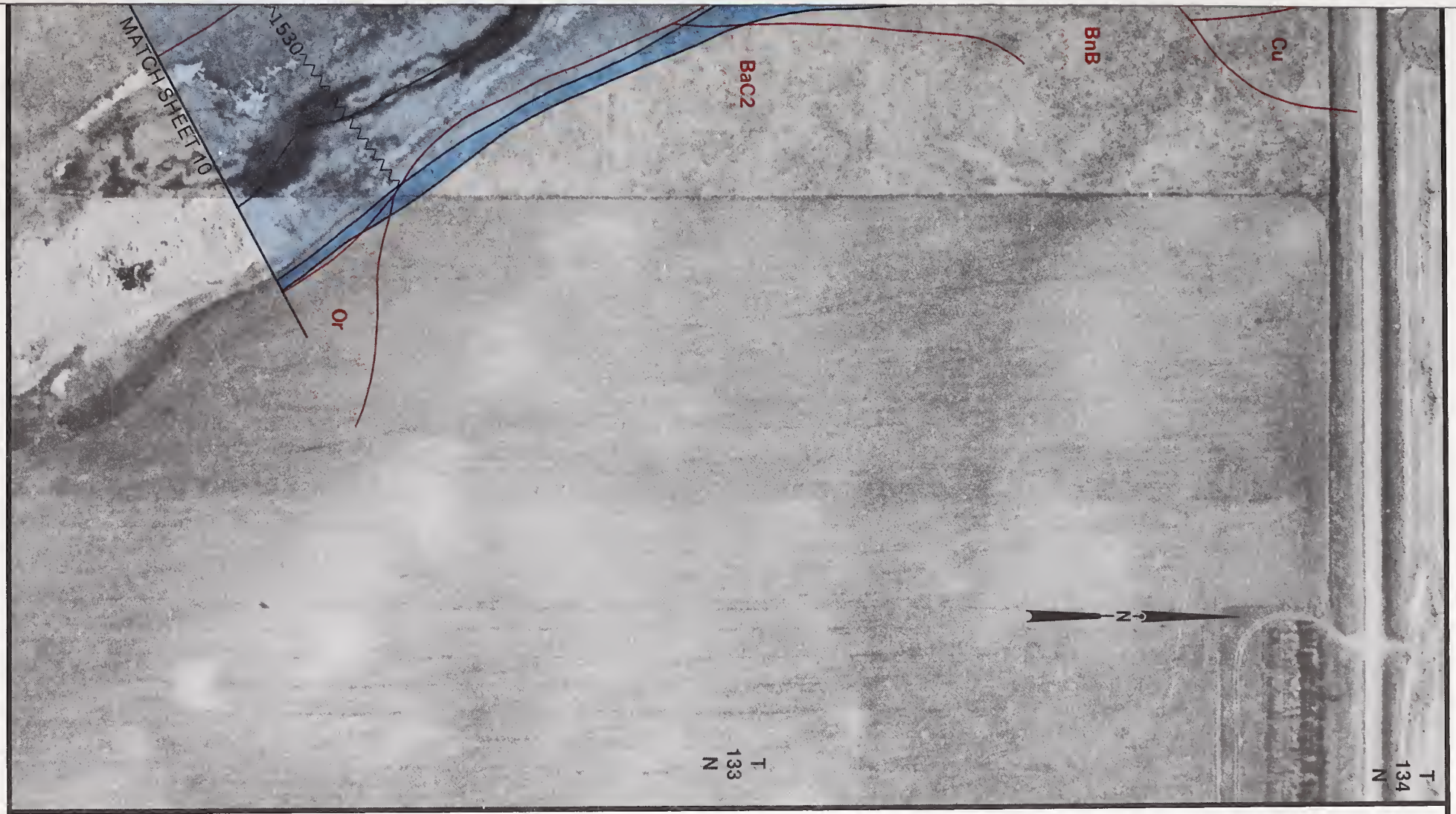

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

M 4.46 VALLEY SECTION

1589 ESTIMATED 100-YEAR FLOOD ELEVATION

BnB SOILS AREA AND SYMBOL

SCALE 0 200 400 FEET
0 50 100 METERS
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MATCH SHEET 3

BnB

Sa

Cu

Cv

BaC2

1531

BnB

BnB

BnB

STATE HIGHWAY

M 1.34

M 1.32

1530.4

END OF STUDY

R 64 W

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

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1589 ESTIMATED 100-YEAR FLOOD ELEVATION

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SCALE 0 200 400 FEET

0 50 100 METERS

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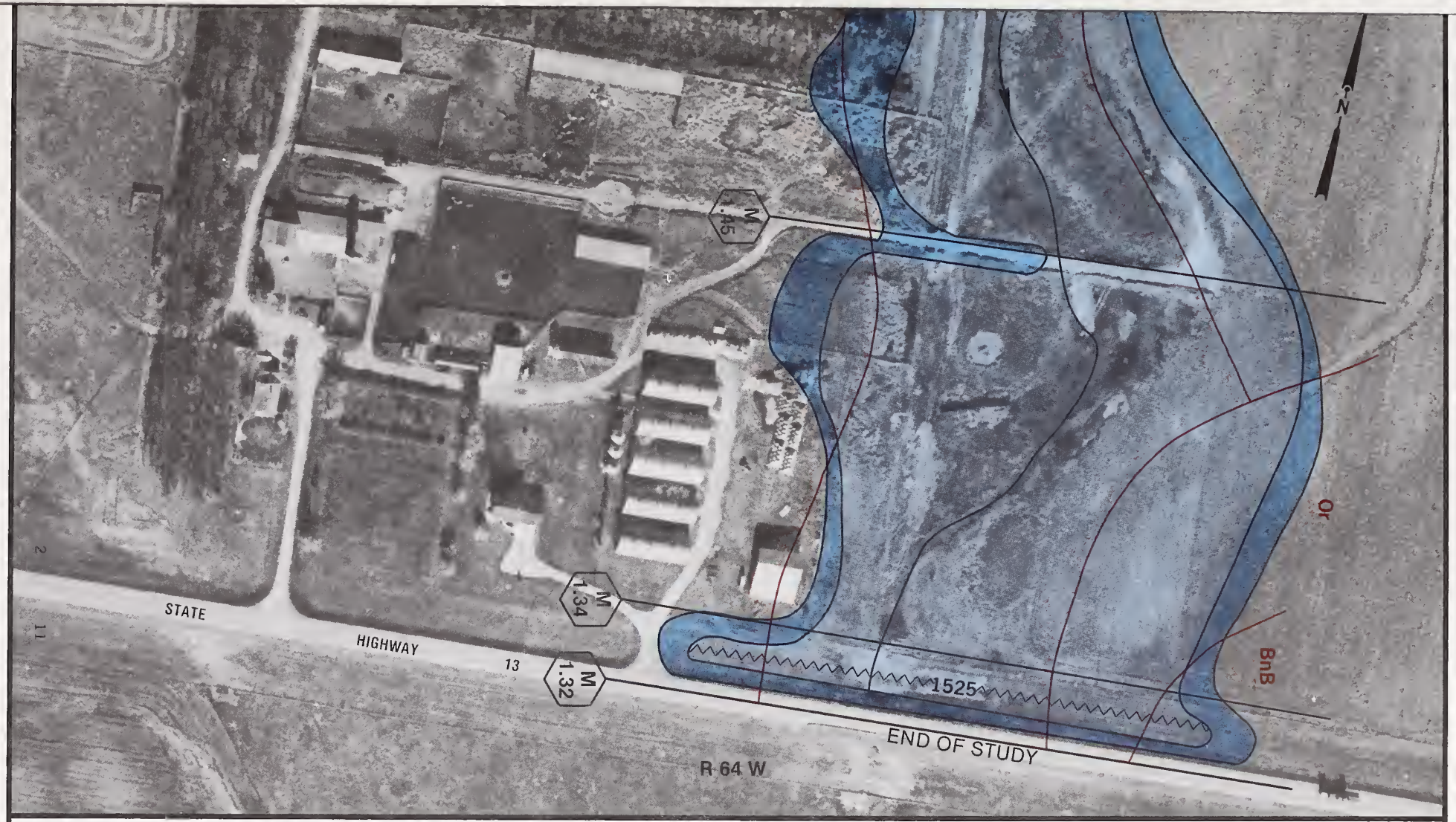

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SHEET 10 OF 10

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
EDGELEY
FLOOD PLAIN MANAGEMENT STUDY
LA MOURE COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

MAPLE RIVER TRIBUTARY

MARCH 1987 4-R 40077

USDA SCS-NATIONAL CARTOGRAPHIC CENTER, FT WORTH, TX 1987

T
133
N

R 64 W

STATE HIGHWAY 13

MAPLE RIVER

1528

1526.8

1525

END OF STUDY

M 1.70

M 1.68

M 1.34

M 1.32

M 4.46

100 YEAR FREQUENCY FLOOD (1% CHANCE FLOOD)

500 YEAR FREQUENCY FLOOD

STREAM CHANNEL

VALLEY SECTION

1589 ESTIMATED 100-YEAR FLOOD ELEVATION

BnB SOILS AREA AND SYMBOL

SCALE 0 200 400 FEET
0 50 100 METERS
APPROXIMATE

OCTOBER 1985 AERIAL PHOTOGRAPHY FROM KBM, INC
DUE TO INHERENT AERIAL PHOTOGRAPHIC DISPLACEMENT, THE PHOTOGRAPHIC IMAGE MAY VARY FROM TRUE GROUND LOCATION

U.S. DEPARTMENT OF AGRICULTURE
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LA MOURE COUNTY, NORTH DAKOTA

SHEET 10 OF 10

FLOOD HAZARD AREA

MAPLE RIVER TRIBUTARY

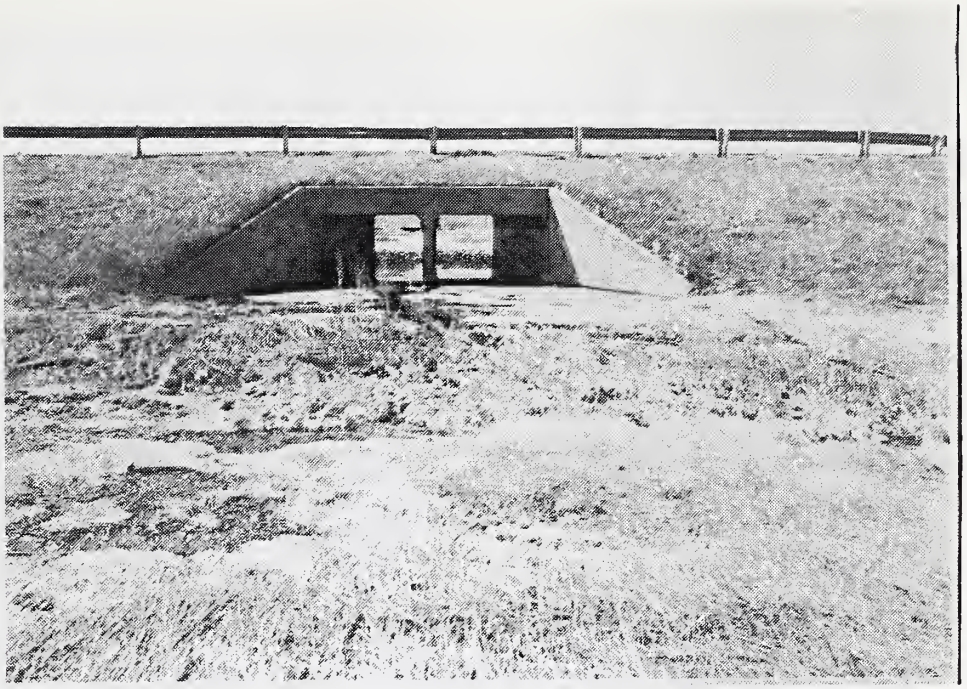
MARCH 1987 4 R 30077

APPENDIX B

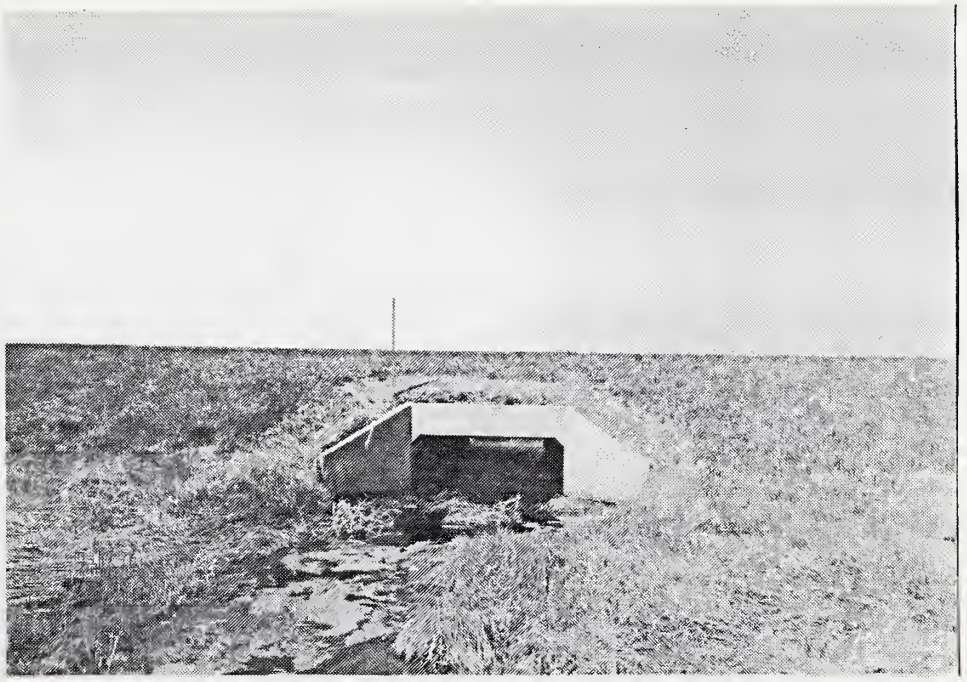
EXISTING BRIDGES AND CULVERTS

A number of bridges and culverts existing at the time of study and used to develop the water surface profile data contained in this document are shown pictorially on the following pages.

The pictures should be helpful in the future to visually check which bridges were in place at the time of study, which were restrictive or in need of replacement and which have been subsequently replaced thus affecting localized flood plains.



M1.32, Box Culvert (Highway 13)
Between Sections 2 and 11, T. 133 N., R. 64 W.

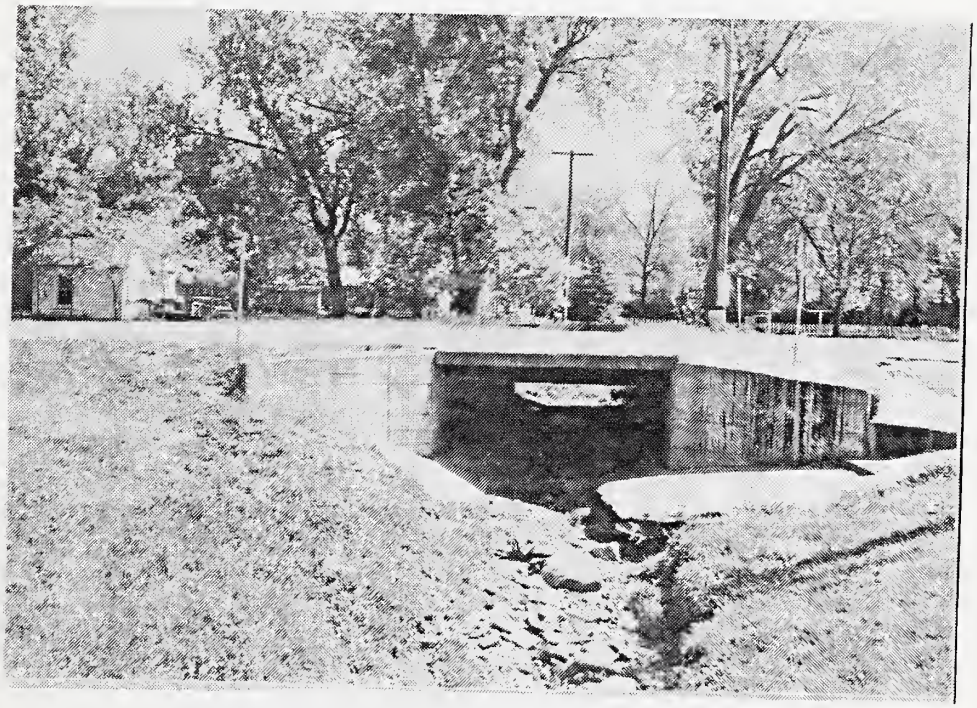


M2.72, Box Culvert (Highway 281)
Between Sections 2 and 3, T. 133 N., R. 64 W.

M3.25, Railroad Reinforced Concrete Pipe
NE¼ Section 3, T. 133 N., R. 64 W.

M3.78, Box Culvert, 8th Ave. and Main St.
SE¼ Section 3, T. 133 N., R. 64 W.

M3.86, Box Culvert, 3rd Street
SE¼ Section 3, T. 133 N., R. 64 W.



M3.93, Box Culvert, 4th Street
SE¼ Section 3, T. 133 N., R. 64 W.

M4.15, Corrugated Metal Pipe, 7th Ave.
SE¼ Section 3, T. 133 N., R. 64 W.

M4.22, Corrugated Metal Pipe, 6th Ave.
SE¼ Section 3, T. 133 N., R. 64 W.

M4.26, Box Culvert, 6th Street
SE¼ Section 3, T. 133 N., R. 64 W.

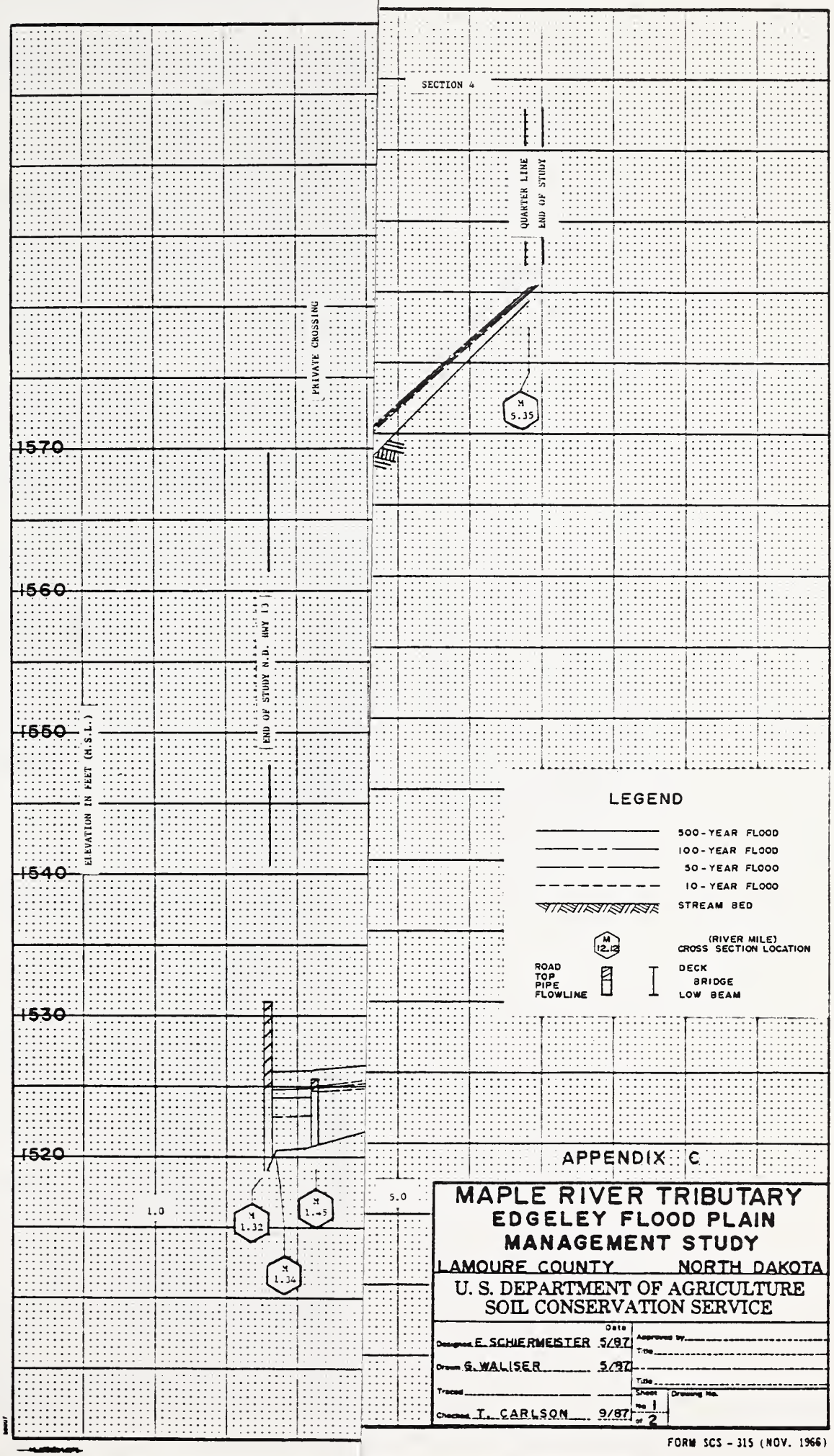
M4.31, Corrugated Metal Pipe, 5th Avenue
SE¼ Section 3, T. 133 N., R. 64 W.

M4.76, Corrugated Metal Pipe, Section Line Road
Between Sections 3 and 4, T. 133 N., R. 64 W.

APPENDIX C

FLOOD PROFILES

Water surface profiles for the 10, 50, 100 and 500 year flood events are shown. Streambed, cross section locations and existing bridge openings are also shown.



APPENDIX C

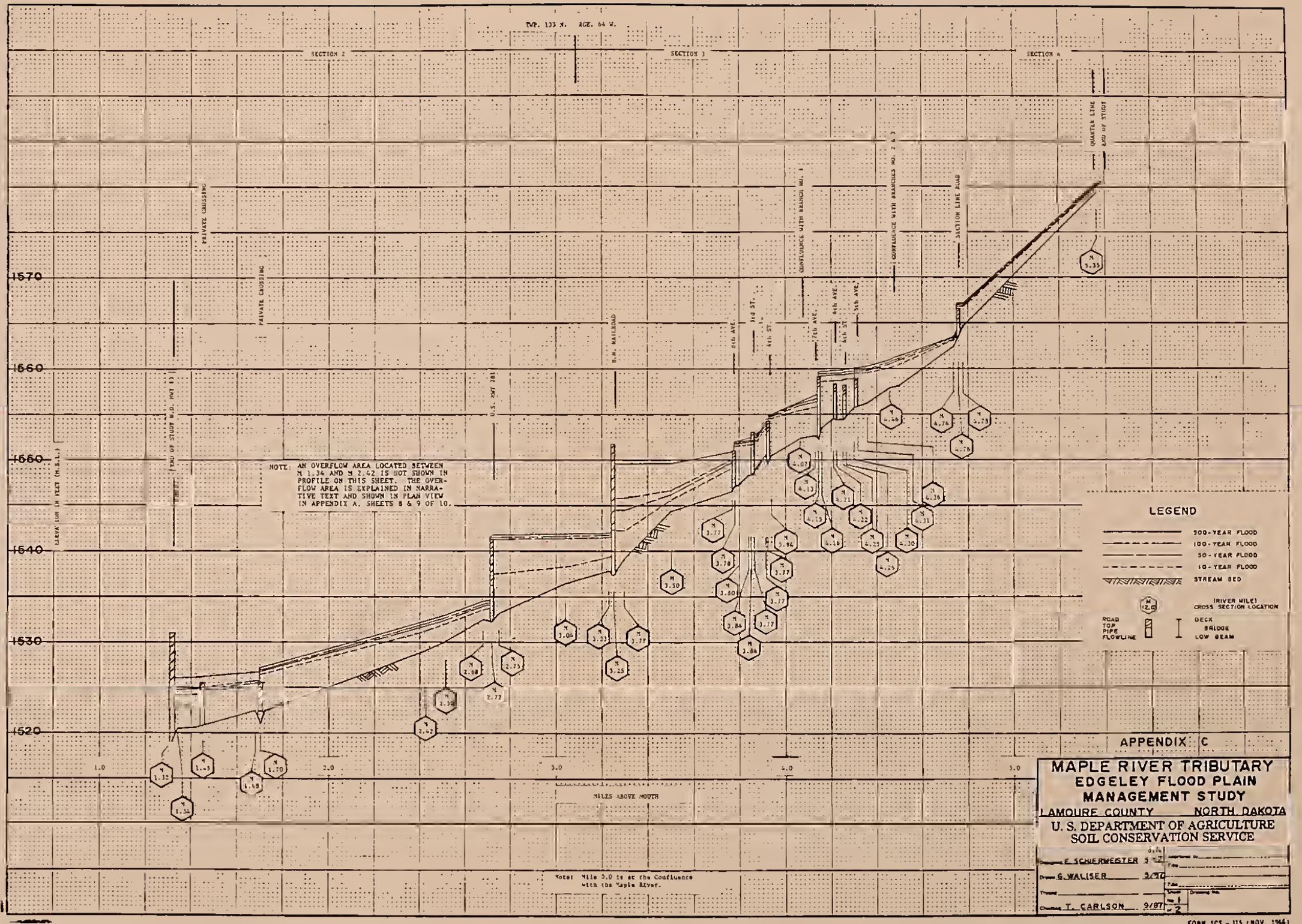
MAPLE RIVER TRIBUTARY
EDGELEY FLOOD PLAIN MANAGEMENT STUDY

LAMOURE COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed E. SCHIERMEISTER	5/87	Approved by
Drawn G. WALISER	5/87	Title
Traced		Title
Checked T. CARLSON	9/87	Sheet No. 1 of 2 — Drawing No.

FORM SCS - 315 (NOV. 1966)



Note: Mile 3.0 is at the Confluence with the Maple River.

APPENDIX C

MAPLE RIVER TRIBUTARY EDGELEY FLOOD PLAIN MANAGEMENT STUDY

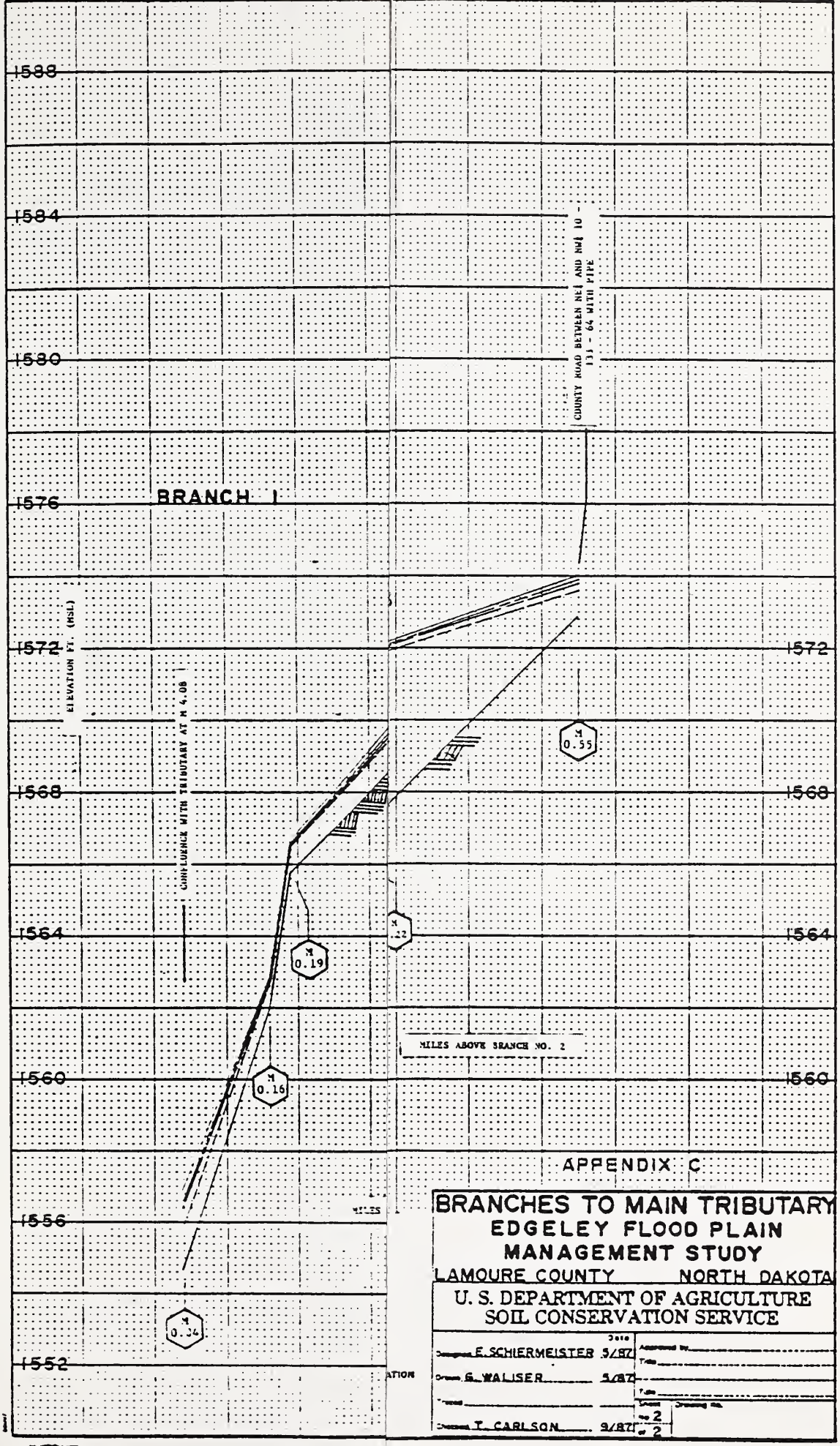
LAMOURE COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

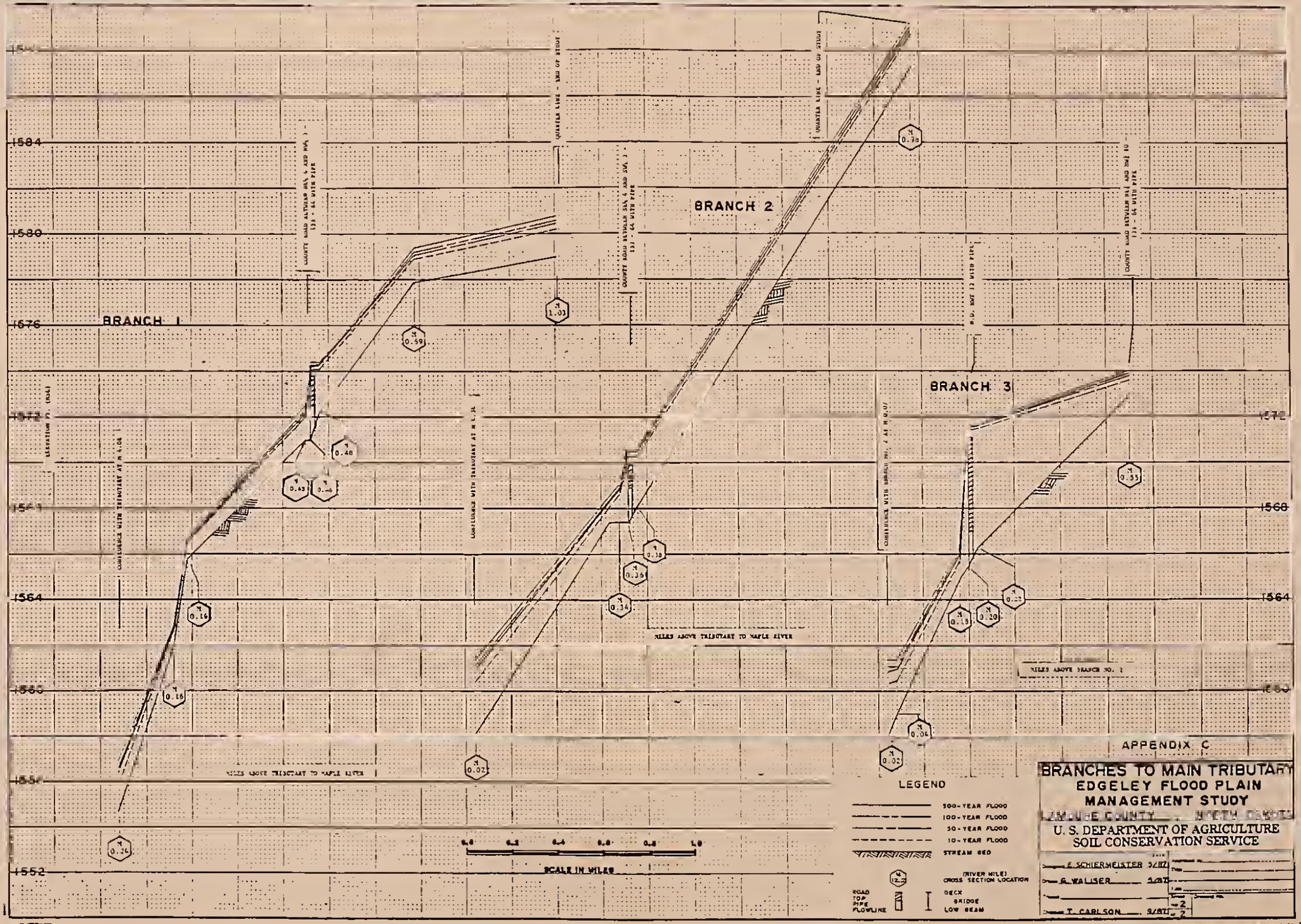
	E. SCHERMEISTER	9/70	
Drawn	G. WALISER	9/70	
Traced			
Checked	T. CARLSON	9/87	

Sheet No. 1 of 2 Sheets

FORM SCS - 315 (NOV. 1966)



FORM SCS - 315 (NOV. 1966)



APPENDIX C

BRANCHES TO MAIN TRIBUTARY EDGELEY FLOOD PLAIN MANAGEMENT STUDY

LA MOURE COUNTY, NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

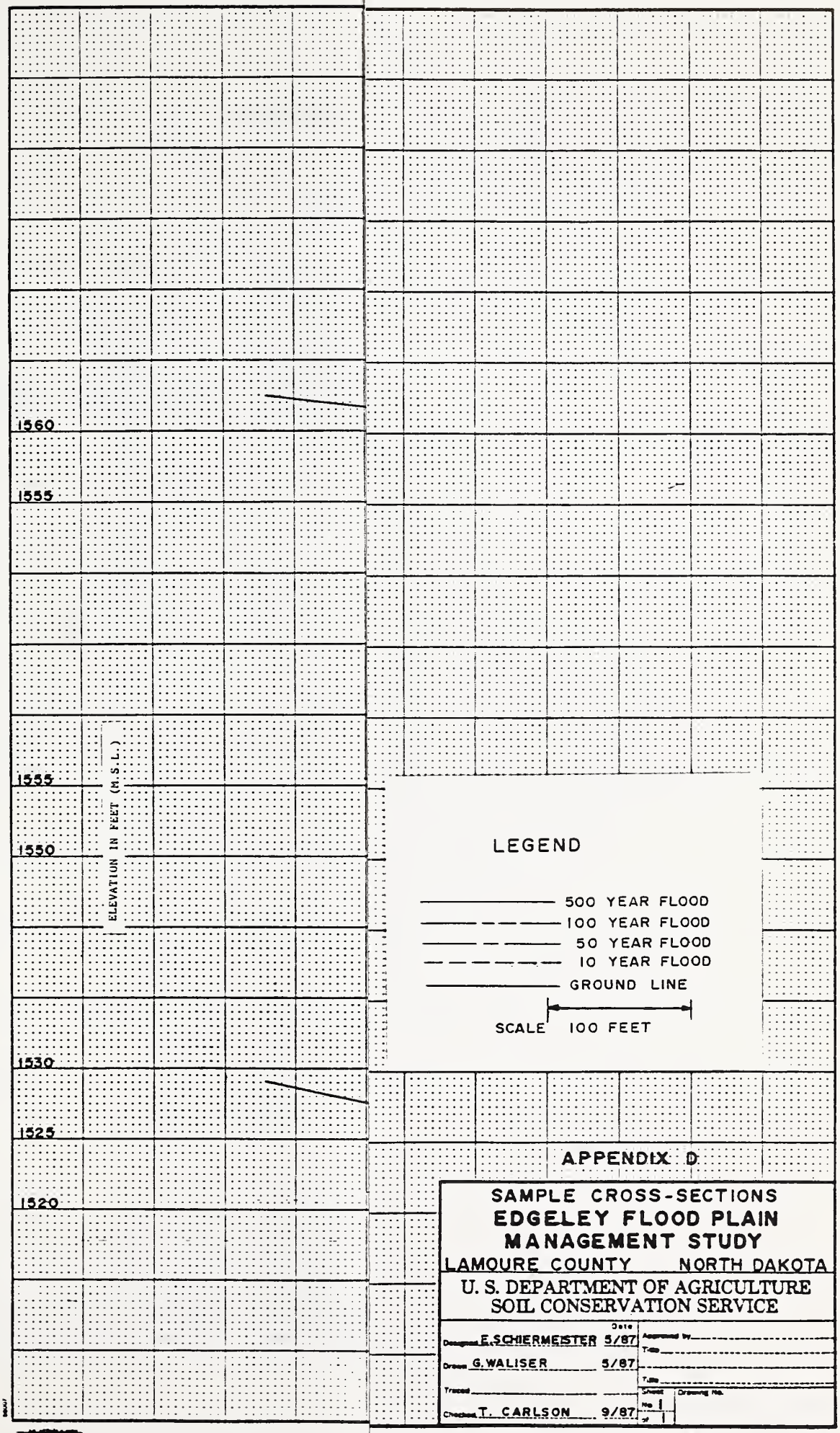
E. SCHIERMEISTER 9/67
G. WALLISER 9/67
T. CARLSON 9/67

FORM SCS - 115 (NOV. 1966)

APPENDIX D

SELECTED CROSS SECTIONS

A few representative cross sections are shown with flood elevations.



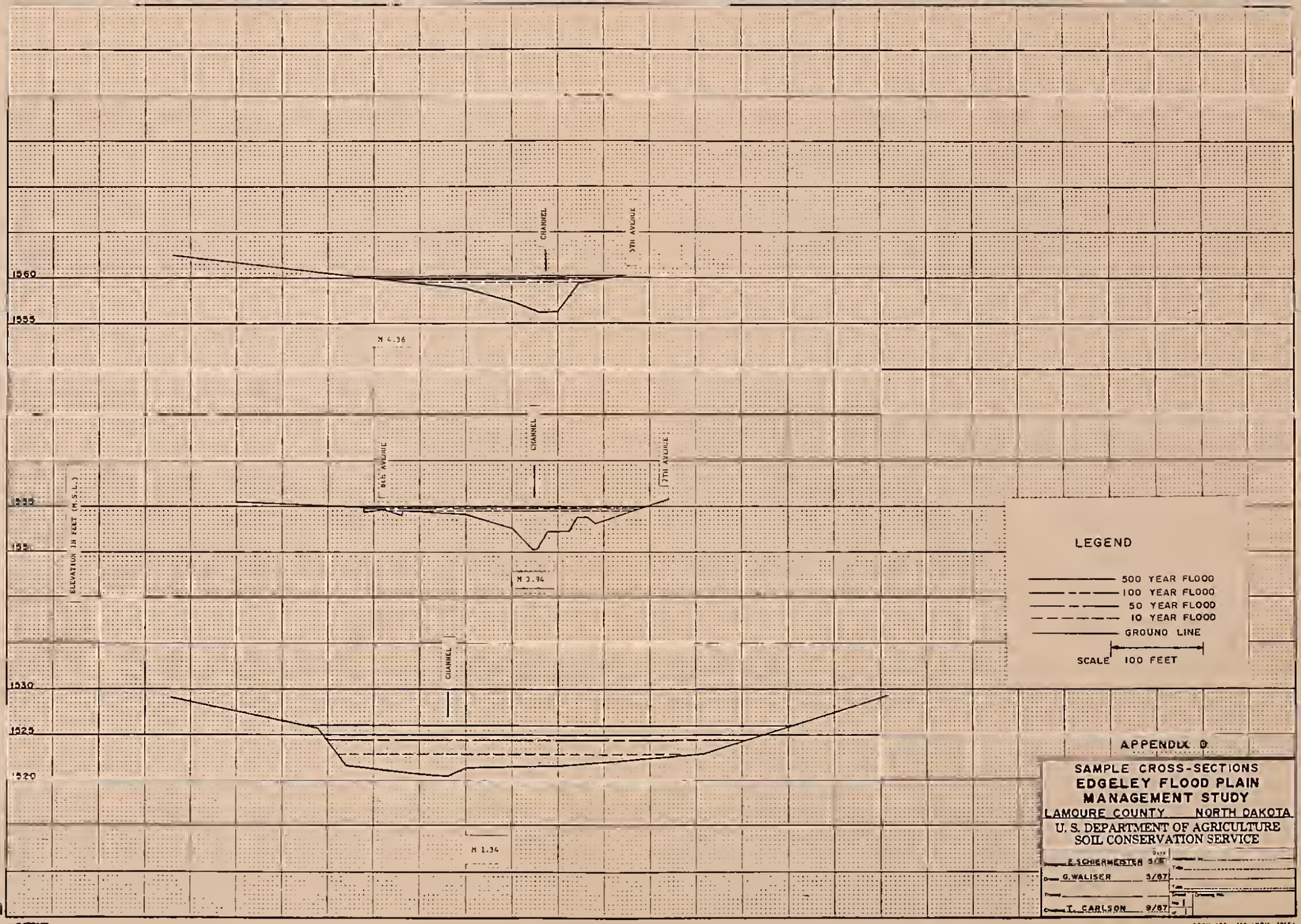
APPENDIX D

SAMPLE CROSS-SECTIONS
EDGELEY FLOOD PLAIN MANAGEMENT STUDY
LAMOURE COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	E.SCHIERMEISTER	5/87	Approved by
Drawn	G.WALISER	5/87	Title
Traced			Title
Checked	T. CARLSON	9/87	Sheet No. 1 of 1 / Drawing No.

FORM SCS - 315 (NOV. 1966)



APPENDIX D

SAMPLE CROSS-SECTIONS
EDGELEY FLOOD PLAIN MANAGEMENT STUDY
LAMOURE COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date
Designed	E. SCHERMEISTER	9/67
Drawn	G. WALISER	9/67
Traced		
Checked	T. CARLSON	9/67

FORM SCS - 215 (NOV. 1966)

APPENDIX E

DISCHARGE-FREQUENCY DATA

EDGELEY

LAMOURE COUNTY

BETWEEN CHANNEL MILES	DRAINAGE AREA (SQUARE MILES)	500-YEAR FREQ. FLOOD DISCHARGE	100-YEAR FREQ. FLOOD DISCHARGE	50-YEAR FREQ. FLOOD DISCHARGE	10-YEAR FREQ. FLOOD DISCHARGE
MAPLE RIVER TRIBUTARY					
1.13					
	3.86	760 (724)[4]	580 (558)	480 (470)	290
2.68					
	2.92	660	500	410	240
3.30					
	2.23	650	460	370	210
4.07					
	1.81	550	380	300	170
4.48					
	.54	150	100	80	50
5.36					
BRANCH NO. 1					
0.00 [1]					
	0.31	120	80	70	40
1.04					
BRANCH NO. 2					
0.00 [2]					
	0.60	200	140	110	60
0.99					
BRANCH NO. 3					
0.00 [3]					
	0.53	210	150	120	70
0.57					

1/ Channel mile 4.08 of Maple River Tributary

2/ Channel mile 4.48 of Maple River Tributary

3/ Channel mile 0.07 of Branch No. 2

4/ Parentheses show tributary flows from M 1.13 to M 2.42, remaining discharge diverted through overflow area. See Appendix A.

APPENDIX F

WATER SURFACE ELEVATION - FREQUENCY DATA

EDGELEY

LAMOURE COUNTY

MAPLE RIVER TRIBUTARY EXISTING CONDITION

RIVER MILE	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
1.32	1526.1	1525.0	1524.4	1522.9
1.34	1526.1	1525.0	1524.4	1522.9
1.45	1526.2	1525.1	1524.9	1524.7
1.68	1526.7	1525.7	1525.5	1525.0
1.70	1527.1	1526.8	1526.7	1526.4
2.42	1532.2	1531.9	1531.6	1531.2
2.50	1533.0	1532.6	1532.3	1532.0
2.68	1534.5	1534.2	1534.1	1533.6
2.72	1541.7	1541.5	1541.3	1537.5
2.75	1541.7	1541.5	1541.3	1537.5
3.04	1541.8	1541.6	1541.4	1538.3
3.23	1541.9	1541.7	1541.5	1539.4
3.25	1549.7	1545.8	1544.5	1542.3
3.30	1549.7	1545.8	1544.5	1542.3
3.50	1549.7	1546.7	1546.2	1545.7
3.77	1550.9	1550.0	1549.7	1549.1
3.78	1552.0	1551.8	1551.7	1551.5
3.80	1552.1	1551.9	1551.8	1551.5
3.84	1552.3	1552.1	1551.9	1551.6

MAPLE RIVER TRIBUTARY EXISTING CONDITION

RIVER MILE	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
3.86	1552.7	1552.5	1552.3	1552.0
3.87	1552.7	1552.5	1552.4	1552.1
3.92	1554.4	1554.1	1554.0	1553.5
3.93	1555.0	1554.9	1554.8	1554.5
3.94	1555.0	1554.9	1554.8	1554.5
4.07	1556.4	1556.2	1556.0	1555.5
4.13	1556.9	1556.6	1556.4	1555.8
4.15	1559.6	1559.4	1559.3	1558.6
4.16	1559.6	1559.4	1559.3	1558.6
4.21	1559.7	1559.5	1559.4	1558.7
4.22	1559.8	1559.5	1559.4	1558.7
4.25	1559.8	1559.5	1559.4	1558.7
4.26	1559.9	1559.6	1559.4	1558.8
4.30	1560.0	1559.7	1559.5	1558.9
4.31	1560.1	1559.9	1559.7	1559.5
4.36	1560.2	1559.9	1559.8	1559.5
4.46	1560.9	1560.6	1560.5	1560.0
4.74	1563.3	1563.2	1563.1	1563.0
4.76	1567.1	1567.0	1567.0	1566.8
4.78	1567.1	1567.0	1567.0	1566.8
5.35	1580.1	1580.0	1579.9	1579.7

BRANCH NO. 1 EXISTING CONDITION				
RIVER MILE	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
0.04	1556.9	1556.6	1556.4	1555.9
0.16	1562.9	1562.8	1562.7	1562.6
0.19	1566.7	1566.6	1566.6	1566.5
0.45	1572.5	1572.3	1572.2	1572.0
0.46	1574.4	1574.2	1574.2	1574.1
0.48	1574.4	1574.3	1574.3	1574.1
0.69	1579.4	1579.2	1579.1	1578.9
1.03	1580.8	1580.6	1580.4	1580.2
BRANCH NO. 2 EXISTING CONDITION				
0.02	1561.4	1561.1	1560.9	1560.4
0.34	1569.0	1568.9	1568.8	1568.6
0.36	1570.7	1570.6	1570.5	1570.3
0.38	1570.7	1570.6	1570.5	1570.3
0.98	1589.2	1589.0	1588.8	1588.6
BRANCH NO. 3 EXISTING CONDITION				
0.02	1561.4	1561.1	1560.9	1560.4
0.04	1561.4	1561.1	1561.0	1560.5
0.18	1566.3	1566.1	1566.0	1565.7
0.20	1571.7	1571.6	1571.6	1571.5
0.22	1571.7	1571.6	1571.6	1571.5
0.55	1574.0	1573.9	1573.8	1573.6

APPENDIX G

INVESTIGATION AND ANALYSES

Surveys

A bench mark survey was established throughout the study area using existing U.S.G.S. Coast and Geodetic Survey Bench Mark data. Elevation reference marks established during the study were used to determine flood elevations. Detailed locations, elevations and descriptions of selected reference marks are shown in Appendix H. Third order levels were used as the base of accuracy in field surveys. All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD).

A total of 59 channel and flood plain cross sections were analyzed throughout a channel distance of 6.64 miles. The geometry of all bridges and culverts were measured and used for computing the water surface profiles.

All cross sections within the study area are located on the photomaps (Appendix B) and shown on the profiles (Appendix C).

Hydrology and Hydraulics

The peak discharges for the 10-, 50-, 100-, and 500-year frequencies were determined by procedures in the Soil Conservation Service National Engineering Manual, Section 4 and Technical Release 20. Peak discharges vary through the study area depending on the size and characteristics of the contributing drainage area. Individual drainages and their peak discharges by frequency are shown in Appendix E.

Water surface elevations for the 10-, 50-, 100-, and 500-year flood events were computed using the U.S. Soil Conservation Service WSP-2 computer program, which performs subcritical backwater computations by a modified step method. The program includes head loss computations at restrictive sections such as roadway bridge openings or culverts, using the U.S. Bureau of Public Roads Method.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen using U.S. Soil Conservation Service guidelines. The channel values varied from 0.035 to 0.050, while the flood plain values ranged from 0.065 to 0.10.

Starting water surface elevations were computed using the downstream watershed slope.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

The 100-year flood was computed to emphasize the effect of constrictions (bridge openings) on flooding and provide a basis for analyzing future improvements. Future projections indicate that expected encroachment will affect the flood stages a slight amount within the study area. The 100-year flood also serves as the base flood which the Federal Emergency Management Agency (FEMA) considers as a minimum for flood insurance requirements.

APPENDIX H

ELEVATION REFERENCE MARKS

MAPLE RIVER TRIBUTARY EDGELEY FLOOD PLAIN MANAGEMENT STUDY

REFERENCE MARK NUMBERS	ELEVATION (MSL)	REFERENCE MARK'S DESCRIPTION
M-38 1/	1558.494	Brass cap at city water tower on 6th Ave. and 3rd Street.
E-2 2/	1527.29	Chiseled X on west end of north headwall of concrete box through Highway 13, between Sec. 2 and 11, T133N, R64W.
E-3 2/	1538.11	Chiseled X on north end of west headwall of concrete box through Highway 281 between Sec. 2 and 3, T133N, R64W.
E-4 2/	1554.30	Chiseled X on northwest corner of bridge abutment on 4th Street between 7th Ave. and 8th Ave.
E-7 2/	1542.81	Chiseled X on top of west end of north 60" RCP through railroad main line, Sec. 3, T133N, R64W.
E-13 2/	1567.11	Chiseled X on north end of 15" RCP approximately 800 ft. east of southwest corner of Sec. 3, T133N, R64W.

1/ Reference marks established by the U.S. Coast and Geodetic Survey.

2/ Reference marks established by Soil Conservation Service.

APPENDIX I

SOILS

The soil information in this report is for only the flood plain area. The soils of LaMoure County are mapped, described, and interpreted in greater detail in the "Soil Survey of LaMoure County, North Dakota." Copies of this survey and help in using soil information are available from the local Soil Conservation Service Office in LaMoure, North Dakota.

Interpretations are given in Table 1 for a number of uses.

Yield Per Acre

The average yields per acre that can be expected of spring wheat under a high level of management are shown in the table. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the soil and the crop. Management can include drainage, erosion control, and protection from flooding; proper planting and seeding rates; use of suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and timely harvesting that insures highest profits. Dashes indicated crops not grown or not suited to the soil.

Land Capability Classification

Land capability classification shows the general suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used

for crops, and the way they respond to management. The grouping does not take into account major and generally expensive land forming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland or engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman Numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants, require special conservation practices or both.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils have limitations that essentially preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter e, w, s, or c, to the class numeral, for example, IIe.

The letter e shows that the main limitation is risk of erosion unless close growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In Class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s or c because the soils in Class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat or recreation.

Important Farmland

Prime Farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short and long-range needs for food and fiber. Prime Farmland is the land best suited to producing food, feed, forage, fiber and oil seed crops. Prime

Farmland may be in pasture, crops, woodland or other land but it is not urban or built-up land or water areas.

Additional Farmland of Statewide Importance (AFSI) is land, in addition to Prime Farmlands, that is of statewide importance for the production of food, feed, fiber, forage, and oil seed crops. Generally, Additional Farmlands of Statewide Importance include those that are nearly Prime Farmland and that economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as Prime Farmlands if conditions are favorable.

Additional Farmlands of Local Importance (AFLI) are lands not designated Prime Farmlands or Additional Farmlands of Statewide Importance (AFSI) that can be protected from erosion and are capable of sustained production of the commonly grown crops. Additional Farmlands of Local Importance (AFLI) are designated by a unit of local government. The term "unit of local government" means the government of a county, municipality, town, township, village, or other unit of general government below the state level, or a combination of units of local government acting through an area-wide agency under state law or an agreement for the formulation of regional development policies and plans.

Soil Uses and Limitations

The soils are rated in Table 1 according to limitations that affect their suitability for playgrounds, picnic areas, dwellings with basements, septic tank absorption fields, sewage lagoons, fill materials for embankments and topsoil. The ratings are based on restrictive soil features such as wetness, slope and texture

of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, is the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreations use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, on site assessment of the height, duration, intensity and frequency of flooding is essential.

The degree of soil limitation is expressed as slight, moderate or severe. Slight means that soil properties are generally favorable and that limitations can be overcome or alleviated by planning, design or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use or by a combination of these measures.

Dwellings

Ratings are made for small dwellings with basements on undisturbed soil. The ratings are based on soil properties, site features and observed performance of the soils. A high water table, flooding, shrink-swell potential and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Septic Tank Absorption Fields

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 to 72 inches is evaluated. The ratings are based on soils properties, site features and observed performance of the soils. Permeability, a high water table, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock, or a cemented pan interfere with installation.

Playgrounds

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hard pan should be considered.

Picnic Areas

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use and do not have slopes, stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Sewage Lagoons

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes

or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

The table gives ratings for the natural soil that makes up the lagoon floor. The surface layer and generally 1 to 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock and cemented pans can cause construction problems and large stones can hinder compaction of the lagoon floor.

Embankment, Dikes, and Levees

Embankment, dikes and levees are raised structures of soil material constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of fill material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper on site investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping and erosion, and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or organic matter, salts or sodium. A high water table affects the amount of usable material.

Topsoil

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity and fertility. The ease of excavating, loading and spreading is affected by rock fragments, slope, water table, soil texture and thickness of suitable material. Reclamation of the borrow area is affected by slope, water table, rock fragments, bedrock and toxic material.

Soils rated good have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated fair are sandy soils; loamy soils that have a relatively high content of clay; soils that have only 20 to 40

inches of suitable material; soils that have an appreciable amount of gravel, stones, or soluble salts; or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated poor are very sandy or clayey; have less than 20 inches of suitable material; have a large amount of gravel, stones or soluble salts; have slopes of more than 15 percent; or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Soil Symbol	Soil Name	Capa Clas Sube	Lagoons 1/ 4/	Dikes, Levees, 5/ Embankments 1/	Topsoil 1/ 5/
BaC2	Barnes loam, rolling, eroded 6 to 9 percent slopes	IIe	: Slope	Severe: Piping	Fair: Small Stones
Bc	Barnes-Cresbard loams 0 to 3 percent slopes				
	Barnes	IIa	te: Seepage	Severe: Piping	Fair: Small Stones
	Cresbard	IIt		Severe: Excess Sodium	Poor: Thin Layer, Excess Sodium
BnB	Barnes-Svea loams, undulating 3 to 6 percent slopes				
	Barnes	IIa	te: Seepage,	Severe: Piping	Fair: Small Stones
	Svea	IIa	te: Slope, ge, Wetness	Severe: Piping	Fair: Small Stones
Ca	Cavour complex 0 to 3 percent slopes	VIt		Severe: Excess Sodium	Poor: Excess Sodium
Cu	Cresbard, Barnes and Cavour loams 0 to 3 percent slopes				
	Cresbard	IIt		Severe: Excess Sodium	Poor: Thin Layer, Excess Sodium
	Barnes	IIa	te: Seepage	Severe: Piping	Fair: Small Stones
	Cavour	IVt		Severe: Excess Sodium	Poor: Excess Sodium
Cv	Cresbard and Cavour loams 0 to 3 percent slopes				
	Cresbard	IIt		Severe: Excess Sodium	Poor: Thin Layer, Excess Sodium
	Cavour	IVt		Severe: Excess Sodium	Poor: Excess Sodium
EbB	Edgeley loam, undulating 3 to 6 percent slopes	IIe	: Depth ock	Severe: Thin Layer	Poor: Small Stones
Es	Exline silt loam 0 to 3 percent slopes	VIe	: Wetness	Severe: Excess Sodium	Poor: Too Clayey, Excess Salt, Excess Sodium
Or	Overly-Aberdeen complex 0 to 3 percent slopes				
	Overly	IIt		Severe: Piping	Poor: Too Clayey
	Aberdeen	IIa	te: Seepage ess	Severe: Piping, Excess Sodium	Poor: Too Clayey, Excess Sodium
Sa	Saline land 0 to 2 percent slopes	VIe	: Floods, ess	Severe: Piping, Wetness, Excess Salt	Poor: Excess Salt, Wetness
Tp	Tonka and Parnell soils 0 to 2 percent slopes				
	Tonka	IIe	: Ponding	Severe: Ponding	Poor: Thin Layer, Wetness
	Parnell	IIe	: Ponding	Severe: Hard to Pack, Ponding	Poor: Wetness

1/ Soil interpretations Lamoure County and parts c

2/ P=prime, AFSI=additional farmlands of statewide

3/ All yields are for drained areas of the poorly

4/ Construction of dwellings, septic tanks and sew necessary the developer should consider the flo

5/ SCS-SOILS Form 5's.

TABLE 1: SOIL INTERPRETATIONS FOR SELECTED USES

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland 2/ Category	Spring Wheat Yield Bu/AC 3/	Dwellings 1/ With Basements 4/	Septic Tank 1/ Absorption Fields 4/	Playgrounds 1/	Picnic Areas 1/	Sewage Lagoons 1/ 4/	Dikes, Levees, 5/ Embankments 1/	Topsoil 1/ 5/
BaC2	Barnes loam, rolling, eroded 6 to 9 percent slopes	IIIe-6	AFSI	23	Moderate: Shrink-Swell	Severe: Perc slowly	Severe: Slope	Slight	Severe: Slope	Severe: Piping	Fair: Small Stones
Bc	Barnes-Cresbard loams 0 to 3 percent slopes		AFSI	34							
	Barnes	IIc-6			Moderate: Shrink-Swell	Severe: Perc slowly	Slight	Slight	Moderate: Seepage	Severe: Piping	Fair: Small Stones
	Cresbard	IIIs			Moderate: Shrink-Swell	Severe: Perc slowly	Severe: Excess Sodium	Severe: Excess Sodium	Slight	Severe: Excess Sodium	Poor: Thin Layer, Excess Sodium
BnB	Barnes-Svea loams, undulating 3 to 6 percent slopes		P	33							
	Barnes	IIe-6			Moderate: Shrink-Swell	Severe: Perc slowly	Moderate: Slope	Slight	Moderate: Seepage, Slope	Severe: Piping	Fair: Small Stones
	Svea	IIe-6			Moderate: Shrink-Swell, Wetness	Severe: Perc slowly	Moderate: Slope	Slight	Moderate: Slope, Seepage, Wetness	Severe: Piping	Fair: Small Stones
Ca	Cavour complex 0 to 3 percent slopes	VIs-SS	AFLI	15	Moderate: Shrink-Swell	Severe: Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Slight	Severe: Excess Sodium	Poor: Excess Sodium
Cu	Cresbard, Barnes and Cavour loams 0 to 3 percent slopes		AFSI	29							
	Cresbard	IIIs			Moderate: Shrink-Swell	Severe: Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Slight	Severe: Excess Sodium	Poor: Thin Layer, Excess Sodium
	Barnes	IIc			Moderate: Shrink-Swell	Severe: Perc Slowly	Slight	Slight	Moderate: Seepage	Severe: Piping	Fair: Small Stones
	Cavour	IVs			Moderate: Shrink-Swell	Severe: Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Slight	Severe: Excess Sodium	Poor: Excess Sodium
Cv	Cresbard and Cavour loams 0 to 3 percent slopes		AFSI	27							
	Cresbard	IIIs			Moderate: Shrink-Swell	Severe: Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Slight	Severe: Excess Sodium	Poor: Thin Layer, Excess Sodium
	Cavour	IVs			Moderate: Shrink-Swell	Severe: Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Slight	Severe: Excess Sodium	Poor: Excess Sodium
EbB	Edgeley loam, undulating 3 to 6 percent slopes	IIs	P	28	Moderate: Depth to Rock, Shrink-Swell	Severe: Depth to Rock	Moderate: Slope, Depth to Rock	Slight	Severe: Depth to Rock	Severe: Thin Layer	Poor: Small Stones
Es	Exline silt loam 0 to 3 percent slopes	VIs	0	9	Moderate: Wetness, Shrink-Swell	Severe: Wetness, Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Severe: Wetness	Severe: Excess Sodium	Poor: Too Clayey, Excess Salt, Excess Sodium
Or	Overly-Aberdeen complex 0 to 3 percent slopes		AFSI	36							
	Overly	IIc			Moderate: Shrink-Swell	Severe: Perc Slowly	Slight	Slight	Slight	Severe: Piping	Poor: Too Clayey
	Aberdeen	IIIs			Moderate: Wetness	Severe: Perc Slowly	Severe: Excess Sodium	Severe: Excess Sodium	Moderate: Seepage Wetness	Severe: Piping, Excess Sodium	Poor: Too Clayey, Excess Sodium
Sa	Saline land 0 to 2 percent slopes	VIs	0	--	Severe: Floods, Wetness	Severe: Floods, Wetness, Perc Slowly	Severe: Wetness, Perc Slowly, Excess Sodium	Severe: Wetness, Perc Slowly, Excess Sodium	Severe: Floods, Wetness	Severe: Piping, Wetness, Excess Salt	Poor: Excess Salt, Wetness
Tp	Tonka and Parnell soils 0 to 2 percent slopes		AFLI	30							
	Tonka	IIw			Severe: Ponding, Shrink-Swell	Severe: Ponding, Perc Slowly	Severe: Ponding	Severe: Ponding	Severe: Ponding	Severe: Ponding	Poor: Thin Layer, Wetness
	Parnell	IIIw			Severe: Ponding, Shrink-Swell	Severe: Ponding, Perc Slowly	Severe: Ponding	Severe: Ponding	Severe: Ponding	Severe: Hard to Pack, Ponding	Poor: Wetness

1/ Soil interpretations Lamoure County and parts of James River Valley, North Dakota prepared by USDA SCS, 1980.

2/ P=prime, AFSI=additional farmlands of statewide importance, AFLI=additional farmlands of local importance, 0=other land.

3/ All yields are for drained areas of the poorly drained and very poorly drained soils.

4/ Construction of dwellings, septic tanks and sewage lagoons is not recommended in the flood plain. However, if construction is necessary the developer should consider the flood hazard and soil restrictions presented in this report.

5/ SCS-SOILS Form 5's.